Inequality, redistribution and growth

Haile, D.

Publication date:
2005

Document Version
Publisher's PDF, also known as Version of record

Inequality, Redistribution and Growth: Theory and Evidence

Inequality, Redistribution and Growth:

Theory and Evidence

Proefschrift

ter verkrijging van de graad van doctor

aan de Universiteit van Tilburg

op gezag van de rector magnificus,

prof. dr. F.A. van der Duyn Schouten,

in het openbaar te verdedigen ten overstaan van een

door het college voor promoties aangewezen commissie

in de aula van de Universiteit

op vrijdag 30 september 2005 om 10.15 uur

door

Daniel Tecle Haile

geboren te Asmara, Eritrea

PROMOTORES: Prof. dr. A.C.Meijdam
Prof. dr. H.A.A. Verbon

To my parents

Preface

The present thesis is the result of four years of research at the Center for Economic Research at Tilburg University. It was a productive time and I enjoyed writing this thesis. Several people have contributed to that and I am happy to express my appreciation in this way.

My foremost thanks go to my supervisors Lex Meijdam and Harrie Verbon. Their enthusiasm and skillful advice formed the optimal research environment for me. In their supervision, they offered me a plenty of freedom and discretion I needed to develop my ideas and interests, without forgetting the fact that I eventually had to write a thesis. The relaxed discussions in their office shaped my research to a considerable extent. They also showed an admirable patience as regards my passion for using different methods; and in fact they are coauthors of some of the chapters of this thesis, and have in that way essentially contributed to this thesis.

I also feel indebted to Professor Karim Sadrieh from Malderburg University (Germany). The discussions, suggestion and criticisms of Karim have been essential for this thesis. His interest in my work was a great encouragement for me. I am, therefore very pleased that he is willing to act as a member of my thesis committee.

Besides, I am very honored that Professor Jeffrey James, Professor Arthur van Soest and Doctor Eline van der Heijden show a great interest in my work and have been willing to participate in my Ph.D. committee. I would also like to thank them for reading and giving valuable advice not only on the final manuscript of the thesis but also on earlier versions of the chapters that I presented earlier on.

Part of this thesis was written during a four-month stay at Helsinki (Finland) - United Nations University (WIDER). The environment there was very stimulating and challenging. I would, especially, like to thank Tony Addison and Tony Sharroks for the regular discussions on the importance of a fair redistributive packages. Furthermore, I would like to express my gratitude to Lex Meijdam and Yohanness Voget for encouraging and helping me to go there, while at the same time they took a part of my teaching obligations.

Most of this thesis was written in Tilburg. The staff of the Department of

Economics has provided me with the efficient and smooth environment necessary to focus exclusively on research, which I appreciate very much.

This thesis has also benefited from the comments of seminar participants at various conferences. The financial support by CentER, Department of Economics and WIDER is gratefully acknowledged.

I would also like to thank my colleagues and fellow graduate students in Tilburg, with special mention to Luuk Van Kempen who edited most parts of my thesis thoroughly, and spent a lot of time discussing my work with me. For company and long conversations about life plus academic affairs, I would like to thank my former office mates at Tilburg University, Ediwn, Mateo, LuuK, Mewael, Michel and Wolf. More so, there are friends who deserve being mentioned, because in one way or another, contributed to making it pleasant and effective to work in Tilburg i.e. Anne, Amar, Attila, Bas, Benedikt, Katharina, Chefena, Chendi, Corrado, Dantao, Emilia, Frederic, Gebre-Mike, Jerun, Judith, Marina, Martin, Mohammed, Mussie, Rosella, Petros, Pierre-Carl, Tu Qin, Yonas, and Yovenni.

Research can only be productive in a challenging, creative and supporting social environment. My family and friends have contributed to this, and I would like to express my appreciation for that. My particular thanks go to my parents, who are ultimately responsible for teaching me to strive for excellence.

Once again, thank you all!

Daniel Tecle Haile

June, 2005.

Contents

1 Introduction **1**

1.1 Background 5

1.1.1 Inequality from a Macro-perspective 6

1.1.2 Inequality from a Micro-Perspective 11

1.2 Research Questions and Rationale for the Methodology 14

1.2.1 Economic Experiments: Microeconomic Foundation of Inequality 14

1.2.2 Joint Determination of Inequality, Taxes and Growth 17

1.2.3 An Empirical Analysis 21

1.3 Outline of the chapters 22

Part I Economic Experiments **29**

2 Malevolent Dictators and Economic Growth **31**

2.1 Introduction 31

2.2 The Model 36

2.3 Experimental Conditions and Procedures 38

2.4 Experimental Results 40

2.5 Conclusions 48

Appendix to Chapter 2 50

3 Which Kind of Heterogeneity Degrades Trust? **57**

3.1 Introduction 57

3.2 Experimental Procedures 60

3.3 Experimental Results 62
3.3.1 Outcomes without race and income information 62
3.3.2 Outcomes with race and income information 64
3.3.3 Discrimination based on race or income? 69
3.4 Determinants of Experimental Decisions 73
3.4.1 Amount sent 74
3.4.2 Amount returned 76
3.5 Concluding Remarks 80
Appendix to Chapter 3 82

Part II Theoretical and Model-Driven 93

4 Inequality, Taxation and Economic Growth 95
4.1 Introduction 95
4.2 The Model 99
4.2.1 The Technology 99
4.2.2 The Households 100
4.2.3 Redistributive Lobbying 102
4.3 Dynamics of Wealth and Redistribution 108
4.4 Redistribution, Spill-overs, and Growth in the Long Run 112
4.5 The Dynamics of Wealth, Redistribution and Growth 115
4.5.1 The effect of the initial wealth distribution 116
4.5.2 An increase in the wage of the skilled 117
4.6 Concluding Remarks 118
Appendix to Chapter 4 121

5 Inequality, Tax Exemptions and Economic Growth 129
5.1 Introduction 129
5.2 The Model 133
5.2.1 The Technology 133
5.2.2 The Households 134

5.3 Tax Exemptions . . . 136
5.4 Technological Shock . . . 143
5.5 The Relation between Tax, Education and Growth . . . 146
5.5.1 Concluding Remarks . . . 148
Appendix to Chapter 5 . . . 150

Part III An Empirical Analysis 161

6 Perceived Inequality counts more than Inequality *per se* 163
6.1 Introduction . . . 163
6.2 Is income inequality really a problem? . . . 167
6.3 Data and Model Specification . . . 169
6.3.1 Data Description . . . 169
6.3.2 Model Specification . . . 170
6.4 Empirical Results . . . 171
6.4.1 OLS Cross-Section Regressions . . . 171
6.4.2 Panel Data Regressions . . . 176
6.5 Conclusion . . . 178
Appendix to Chapter 6 . . . 180

7 Non-Monotonic relations between Redistribution and Growth 187
7.1 Introduction . . . 187
7.2 Hypotheses . . . 190
7.3 Data and Model Specification . . . 191
7.4 Empirical Results . . . 196
7.5 Conclusion . . . 201
Appendix to Chapter 7 . . . 202

Summary in Dutch 211

Chapter 1

Introduction

Since the 1990s, global output has grown by over 3 percent annually and inflation has slowed down virtually in all regions of the world, suggesting the average income has increased. But beyond the average level of income, economists are interested in how income is divided among a country's residents, that is, in the distribution of income. One of the reasons to pay attention to distribution is its relationship to poverty. For any given average level of income, if income is distributed more unequally, more people are likely to live in poverty. For example, in 1995 the average income per capita in Paraguay ($\$5,731$) was 50% larger than the average income per capita in Egypt ($\$3,853$). But the fraction of the population living on an income of less than one dollar per day was 19.4% in Paraguay, compared with only 3.1% in Egypt. The reason for this difference is that the distribution of income in the latter is more equal than in the former (World Bank, 2002).

Has Inequality Increased?

Research shows that the gap between the poor and the rich is increasing in several countries. For example, in the United States the tendency towards a reduction in economic difference was reversed around 1970 and the gap has broadened in the 80's and 90's. In the United States and the United Kingdom, the Gini[1] increased

[1] The Gini index measures the gap between the rich and poor. In the perfectly equal egalitarian society, the Gini would be 0. The higher the Gini, the more unequal the distribution of income. In a perfectly unequal society, in which one person (or household or family) had all the income,

by 1% and 2% a year between the late 1970s and 2% percent a year between the late 1970s and the mid-1990s (Gottschalk and Smeeding, 1997). However, the most radical changes have occurred as a result of the transition to market economies in Eastern Europe and in large parts of the Third World. For example, until the late 1980s transition economies had the most equal income distribution: the average Gini was around 25. However, this had changed by the mid-1990s, by which time the average Gini coefficient rose to the low 30's (Bourguignon and Morrison, 2002).

Why Has Inequality Increased?

A shift in labor demand away from the unskilled and disadvantaged, in favor of the skilled and socially adaptable, is one of the major reasons for the rise in inequality. Evidence shows that there is a positive relationship between the distribution of skills by educational attainment and the distribution of wages (Kruger, 1993 and Acemoglu, 1999). A question arises whether the conventional explanation for analyzing changes in relative wages are adequate? Aghion *et al.* (1999) argued that the answer is no. The decline of centralized bargaining (Lindbeck and *et al.* 1999), globalization and organizational change are also factors that need to be blamed for the rise in inequality. Tanzi (1998), for example, thinks that government's discriminatory behavior is another source of inequality. Therefore the causes of the rise in inequality are different.

Should We Care about the Rise in Inequality?

Inequality might not be a matter of concern in itself. In economics, there is a tendency to believe that with the Pareto principle a change is considered to be good (Pareto improvement), if it makes someone better off without making anyone else worse off. A change that increases the incomes of high-income individuals without decreasing the incomes of others makes some people better off without making anyone else worse off. Whether a change in measured inequality is to be perceived as acceptable by members of a society might depend on social norms,

its value would be 100.

however.

Perception of equity derives from social and cultural norms and each society will emphasize its own values as to what is equitable or not (Hofstede and Gert Jan, 2004). Forbes Magazine (1998, *p.*8) indicates that in 1997, Bill Gates increased his wealth at the rate of $21.1 million per hour. Likewise, some professional athletes, entertainers and actors are receiving millions of dollars. Could this be a public concern in the US? Unlikely so, but it might be in other more egalitarian societies like Sweden and Norway. Nevertheless, regardless of the public attitude towards such issues, an increase in income inequality has a large impact on the income distribution that a country ends up with. But equity concerns are undoubtedly present at the individual level as well. Probably few would deny that individuals care about their relative standing in some reference group and hold rather well defined perceptions about a fair distribution of income.

Experimental evidence shows that individuals are motivated by fairness notions. That is individuals dislike unequal distributions or outcomes (Guth, 1995). Interestingly however, it is not only the distribution of the pie that individuals care about, but also the intentions of their fellows (Rabin, 1993; Dufwenberg and Kirchsteiger, 1998). The result suggests that fairness models should not only take into account that many people have a preference for a certain distribution of income but also that many people value the fairness intentions behind actions.

In other words, people pay attention to the characteristics of others when making strategic decisions (e.g. the tendency to cooperate or not) and hence, the role of intentions is important. Indeed, motives underlie an intentionality process in which the willingness to cooperate is influenced by one party's perception about the intentions of the other party. If one party perceives another to have only selfish intentions (e.g. nepotism, discrimination), trust is unlikely to develop, but if an attribution of altruistic intention is made, trust may result. If this is true, then individual interactions are most likely to depend on people's observations of the other party and attempt to assess their intentions in exchange. If some members get rich unfairly, individuals react more negatively than when they "deserve" it. If, for example, a political leader favours one ethnic group above others, people from

other ethnic groups probably don't have positive attitudes towards this inequality, and behave accordingly. While the same people might not feel bad about a group of sportsmen that earns a lot of money in a champions league. Or, to give another example, if inequality is perceived to be caused by corruption, members of a society might be less motivated to cooperate than in situations, in which variation in talents or efforts generates inequality in income.

If "perceived inequality" concerns are important for human motivations, it is relevant to consider their impact on macroeconomic performance of the economy. The propensity to cooperate has an important implication for growth. A society's solution to improve social cohesion or cooperation may be influenced by those "perceived inequality" concerns.

Can the degree of Inequality affect Redistributive Outcome?

There are some policy problems for which a wider view of inequality is necessary. In designing a tax system to raise money to finance public expenditure, the shape of the income distribution matters in determining the appropriate tax schedule. Thus, the shape of the entire distribution is relevant to certain policy issues. These trends renewed the concern about the fundamental trade-off between efficiency (growth) and equity (social justice), the former requiring more inequality whereas the latter would call for redistribution through the political process.[2] The theoretical basis for their separation is the Second Fundamental Theorem of Welfare Economics, which holds that any Pareto efficient outcome can be implemented as a competitive equilibrium given the appropriate lump sum taxes and transfers.

Recent research has opened up a number of avenues for thinking about the consequences of inequality. One strand stems from the observation that in practice the government cannot use lump sum taxes and transfers to serve distributional goals. Taxes or transfers based on income or on other variables which can affect individual action are distortionary by nature. Developments in the economics of information have established that in the presence of imperfect information markets

[2]The idea that incentive considerations may generate a trade-off between equity and efficiency goes back to Mirrlees (1971).

are not even Pareto efficient (Greenwald and Stiglitz, 1986). There is some government action that can make at least some people better off while not making anyone worse off. An implication of this result is that distribution does matter; changing the distribution of income or wealth can affect the efficiency of the economy.

This thesis aims at contributing to our understanding of the complex relationship between income inequality and growth. The topic is an old one that has received much attention from economists. The seminal contribution in alarming the importance of income distribution came from Kuznets (1955) who proposed a hump-shaped relationship between the stage of economic development and income inequality.[3] This thesis makes a novel contribution to our understanding to the relationship between Inequality and Economic Growth. It blends politics with economics, micro with macro economics and theory with empirics. In various ways the concept of inequality is unraveled and the dynamic interrelationship between inequality, redistribution and growth is reexamined. In so doing it takes on a range of topics, from trust, propensity to cooperation, corruption and taxes, to the importance of the perception of inequality.

This chapter provides an introduction to the rest of the thesis and is organized as follows. Section 1.1 reviews some of the existing theories and evidence on the effect of inequality on the performance of the economy. Section 1.2 presents the research questions which emanate from the gaps in the literature. Moreover, this section explains the methodology used in addressing the research questions and provides an overview of the scientific significance and innovative aspects of the thesis. Section 1.3 provides the outline of the thesis.

1.1 Background

The next subsection contains a survey of the literature on the importance of inequality from both macro and micro perspectives. Weak spots will be identified

[3]The thesis focuses primarily on how the distribution of income can affect output growth, rather than on the reverse effect from the level of development to inequality. It thus barely touches on the Kuznets hypothesis.

that serve as a motivation for the research reported in the subsequent chapters.

1.1.1 Inequality from a Macro-perspective

The relationship between income inequality and growth has been under heated debate for nearly half a century. The next sub-section highlights the theoretical framework of the relationship between growth and inequality and, moreover, it discusses the question whether the existing empirical studies provide a solid and conclusive relationship between income inequality and economic growth.

Most theoretical studies model not only different channels to the relationship between inequality and economic growth, but also different effects of inequality on growth rates. We present different channels through which inequality has been hypothesized to affect economic growth, the potentially most important of which are briefly surveyed here.

Inequality, Saving and Capital Accumulation One channel through which income inequality can have a stimulating effect on capital accumulation and growth is saving rates. Kaldor's (1956) growth theory argues that the capital-labor ratio is driven to its steady state equilibrium value by the different saving rates of the rich (who save much) and poor (who save little). The assumption is that the propensity to save is higher for entrepreneurs than for workers, so that increasing inequality will result in higher savings and thus more rapid capital accumulation and growth.[4]

The earliest paper, which supports the idea that inequality is good for capital accumulation comes from Patridge (1997). He uses US state level panel data and confirmed that, when fixed effects are controlled for, inequality enhances growth. Similarly, Li and Zou (1998) and Forbes (2000), using panel data and introducing country-specific fixed effects, find that an increase in the level of a country's income

[4] Another explanation put forward for why inequality is good for growth is that paying workers based on their productivity could increase efforts and thereby economic growth. According to Mirrlees (1971), in a moral hazard context where output realization depends on an unobservable effort borne by employees, rewarding the employees with a constant wage independent from the observable output performance, will obviously discourage them from investing any effort.

inequality has a significant positive relationship with subsequent economic growth. These studies average the dependent variables over five-year periods and this can be interpreted as saying there is evidence for a short run positive effect of inequality on growth.

Nevertheless, this conventional wisdom has been challenged by adherents of endogenous growth theory pointing to several reasons why excessive inequality may actually reduce investment opportunities and incentives and thereby discourage growth.

Capital Market Imperfections This approach is based on the role played by imperfections in capital markets. In societies where credit constraints prevent the poor from undertaking efficient investment, inequality leads to lower growth. This is because, a relatively large share of the population is below the threshold cost of education and lacks the incentive to take this opportunity (cf., Aghion and Bolton 1992 and 1997; Galor and Zeira, 1993; and Saint Paul and Verdier, 1993).

Much of the elements of these channels from income distribution to growth can be tested directly. In a cross-country analysis, Perotti (1994, 1996) and Figini (1999) find that the existence of borrowing constraints have given rise to a decline in human capital accumulation. Barro (2000) extends the work by taking a representative sample i.e. increasing the number of countries. He applies three stage least squares (3SLS), averaging the dependent variable over a 10 year period, and finds a non-linear relationship i.e. the overall relationship between inequality and growth is nearly zero, but negative in poor countries and positive in rich countries. In particular, inequality appears to be good for growth at high levels of income but bad for growth at low levels of income. The reason behind this result is that poorer countries have less organized financial markets. Deininger and Olinto (2000), using panel data studies, provide additional evidence for the relationship between inequality and growth, but also find that asset inequality, rather than income inequality, reduces the effectiveness of education to growth. The higher significance of asset inequality compared to the income distribution is consistent with the view that collateral-related constraints limit the ability of the poor to

access credit markets and thus to accumulate human capital which is important for growth.

In another study, Perotti (1996) suggests that inequality has a negative effect on economic growth through the distortion of the households' decisions on education and fertility. High inequality implies that more relatively poor and borrowing constrained households invest in the quantity rather than in the quality of their offspring, thus leading, assuming other things remaining constant, to less investment in human capital and to less growth. That's to say, parents have to optimize the use of the household resources through an improvement in quality (education) or in quantity (fertility) of their offspring. Since education has a cost equal to the income forgone while at school, poor households invest in the quantity of children rather than in their human capital. He finds strong evidence that equality is associated with lower levels of fertility. He argues that when people are investing in human capital, the opportunity cost of raising children becomes significantly higher.

Sociopolitical Instability The third potential channel between inequality and growth is based on sociopolitical instability (Alesina and Perotti, 1996; Benhabib and Rustichini, 1996). According to this approach, inequality is an important determinant of sociopolitical instability. That is, political instability could emanate as different groups compete for power. Inequality exacerbates social conflict, which in turn makes the property rights less secure, lowers the expected return to investment and therefore, reduces growth.

To test the sociopolitical instability approach, Perotti (1994,1996) and Alesina and Perotti (1996) proxied the political instability by two measures, already used in other studies of endogenous growth: the Gastil Index of civil rights (Gastil, 1989) and a weighted sum of the annual number of political assassinations and coups over a certain period under consideration. They find strong evidence for the notion that inequality leads to sociopolitical instability and thus to slow growth.[5]

[5]Rodrik (1998) has also provided empirical evidence that societies are less likely to carry out the adjustment necessary to respond to a negative macroeconomic shock. The reason behind this scene is believed to be an interaction of poor quality institutions and high inequality.

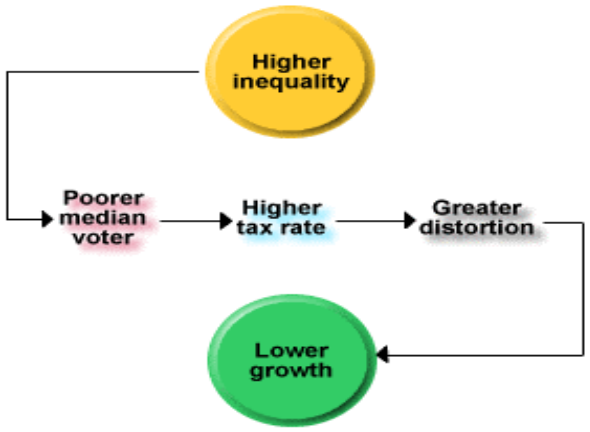


Figure 1.1: Median Voter Channel.

Political Economy The fourth channel, the political economy approach, attempts to unify the endogenous growth theory with the endogenous fiscal policy literature, building on the theorem of the median voter (Alesina and Rodrik, 1994; Bertola, 1993; Persson and Tabellini, 1994). In the absence of perfect information about people's type, any redistributive tax and transfer need to be conditioned on variables that are influenced by individual decisions and are thus distortionary. In democratic societies, where the level of taxation is decided by the median voter, majority rule would dictate a high level of redistribution. This is, because in unequal societies the median pretax income is below the mean income. As Figure 1.1 shows, when the median voter is poor, the rate of taxation preferred by him/her will be higher and this lowers the level of efficiency. Through this channel, inequality lowers growth.

The first who tested this approach are Persson and Tabellini (1994) and Alesina and Rodrik (1994). Alesina and Rodrik (1994) and Persson and Tabellini (1994) use cross-national regression to test their political growth model in which inequality affects growth through the median voters. They find, as predicted, that inequality reduces growth in a sample of democracies, but has no effect in the sample of non-democracies. The empirical predictions of the median voter approach, however, do

not seem to be robust.

Extensive reviews of the research on inequality and redistribution have recently appeared in the literature. Perotti (1994, 1996), Alesina and Perotti (1996) and Figini (1999) find that many redistribution measures do not have a positive relationship with inequality. Besides, policy variables do not enter negatively into the growth equation at a significant level. Using the social security/welfare spending and spending for health/housing as a redistribution measure, Perotti (1996) finds even a positive and significant relationship between redistribution and growth. Persson and Tabellini (1994) find a negative but insignificant impact of the ratio of the government transfers on the growth rates, whereas Sala-i-Martin (1996) finds a positive and significant impact of government transfers on growth.

To explain this phenomenon, Benabou (2000) provides a theoretical underpinning for the existence of a wealth bias in a political system, arguing that the decisive voter has a higher income than the median voter. If his income is sufficiently high, then redistribution will raise his/her cost and hence he/she will oppose a higher taxation. Similarly, Bourguignon and Verdier (2000) present endogenous political participation to explain why more inequality is correlated with less taxation and less growth. In their model, by assuming a wealth bias in any form of political system, they show the rich could block redistribution.[6]

Heterogeneity and the Propensity to Cooperate Last but not least, there is a strand of literature which relates the degree of heterogeneity in the population to the trust level, where trust is defined as the degree to which members of society trust others in carrying out transactions.[7] Growth often demands investment which is inter-temporal. Knack and Zak (2001) argue that since there are no complete contracts, in most cases an intertemporal contract has some degree of trust in it. They argue that in the absence of reputation, trust could evolve in intertemporal

[6]It implies that higher inequality could lead to lower redistribution as the rich people are the only participants i.e. political participation is not universal. For these authors, an increase in inequality could lead to a fall in redistribution

[7]The idea that transaction costs create inefficiency in the economy goes back to the seminal work of North (1990).

exchange because it reduces transaction costs. Heterogeneity can lead societies to become less reliant on trust, lowering investments and thus results in a decline in growth rates for a given economy.

Efforts have been made to measure individual trust using a statistical analysis which relies on survey questionnaires. Surveys in many countries asked respondents, "Generally speaking would you say that most people can be trusted, or that you can't be too careful in dealing with people?" Knack and Keefer (1997) and Knack and Zak (2001) identified social homogeneity measured in terms of ethnic or race homogeneity and inequality to be an important determinant of trust in one-shot transactions. They provide evidence that trust declines continuously as social distance increases. They find that a one standard deviation decrease in the trust index decreases economic growth by more than one-half of standard deviation.

1.1.2 Inequality from a Micro-Perspective

The ability of people in a society to cooperate for the common good is an important determinant for economic success. For example, Knack and Zak (2001) argue that the ability to cooperate is influenced by the degree of homogeneity (culture, income, race, religion etc.), but determining whether this is so is complicated by the fact that we do not usually observe people's propensity to cooperate, only whether they actually cooperate. Perhaps differences in cooperation are determined by the different environments in which people find themselves rather than by differences, say, in income. To find the true extent to which homogeneity determines the propensity to cooperate, experimentalists observe how much people from different income groups cooperate when placed in the same environment.

Economists have recently conducted experiments to probe into heterogenous population in behavior, holding the economic environment fixed. Consider, for example, a dictator game in which player 1 (proposer) was given a sum of money and allowed to propose a division between himself and the other member of the pair, called the responder and who has no decision to make. The proposer does not have to be afraid of any possible punishment by the other player and can

thus choose his preferred outcome. The unique Nash prediction for player 1 with selfish preferences is to take all the money since it leads to higher monetary payoffs. Experimental evidence shows that the proposer does not take all for himself and dislikes inequality in monetary payoffs. It is not regarded as a fair distribution to keep all the money.

In an extended game, in ultimatum game, when two players bargain (anonymously) to divide a fixed amount between them, the first player (proposer) offers a division of the "pie". The second player (responder) decides whether to accept it or not. If the responder accepts both players get their agreed upon shares but if the responder rejects both players get nothing. The rational solution is predicting that the proposer should offer the smallest possible share and that the responder should accept it. Almost all experimental evidence suggests that humans disregard the rational solution in favour of some notion of fairness. That is individuals dislike unequal distributions.[8]

Interestingly, however, it is not only the distribution of the pie that players care about, but also how people determine attributions for observed outcomes. Attribution theory considers a chain of events in which a person asks why an outcome occurred, assigns an attribution for the cause, and behaves accordingly. For example, in Blount (1995) responders in an ultimatum game accept a substantially lower proposal when it is generated randomly than when chosen by a self-interested party.

Economists provide economic models that take into account the intentions of players (Rabin, 1993; Dufwenberg and Kirchsteiger,1998). In an experimental study Falk *et al.*, (1999) show that the rejection rate depends on the available alternatives i.e. the same degree of unequal distribution of payoffs produces different rejections by the responder. The result suggests that fairness models should not only take into account that many people have preferences over the distribution of income but also that many people value the fairness intentions behind actions.

Efforts have also been made to measure individual trust using economic exper-

[8]The average offers are in the regions of 40-50% of the pie. About half of the responders reject offers below 30%.

iments. Consider for example the seminal trust game experiment of Berg *et al.* (1995). In their experiment, player A, the trustor, has an initial endowment $P > 0$ and can send an amount p to player B, the trustee, with $p \leq P$. Player B receives $3p$ and can return to player A any amount z, with $0 \leq z \leq 3p$. The final payoff for player A is $P - p + z$, and for player B it is $3p - z$. The amount p can be used as a measure for the trustor's trust in an anonymous interaction partner. In their setting, trust is the willingness to transfer a positive amount ($p > 0$) to the other person in the hope that this person will reciprocate at her own cost. The return z, in relation to the received amount $3p$, is an indicator for a subject's reciprocal behavior. The higher z – for a given p – the greater the degree of reciprocity.

When this game is played, there exists no significant difference across different countries on the level of trust and reciprocity. On average the amount sent is 50% of the initial endowment (Camerer, 2003). But, the result becomes fragile when information about the partner is revealed. Recently, experimental studies have established that racial or ethnic heterogeneity between individuals on the willingness to cooperate when the game is played with provision of information about the partner i.e. race in Burns (2003) or ethnicity who must infer from the last name of their partners in Gneezy and Fershtman (2001). Their experimental result suggests that trust decreases between different ethnic or race groups.

Another closely related strand of the experimental literature is the public good game and, in particular, the literature that considers how voluntary contributions depend on the income distribution. The public good game illustrates the basic paradox of cooperation i.e. the individual gains by not cooperating, but if all defect, they get less than they would if they cooperated. The social dilemma results from the situation in which a group shares a common output and in which each individual must decide to contribute or not. It turns out that "rationally" the best choice of the individual is to "free-ride" if she/he can share in the group rewards regardless of her/his contribution. Chan *et al.* (1996, 1999) and Sadrieh and Verbon (2002) explore Warr's (1983) conjecture that group contributions are independent of the degree of inequality. Their finding is that "on average" this turns out to be true: the Nash equilibrium, predicting an average contribution

independent of the initial income distribution could not be rejected as the null hypothesis.

It has been shown that while income inequality and race are an important determinant of the level of stated trust, the relationship between inequality, race and the social cooperations from micro economic side is certainly open to further empirical investigation. For example, the literature so far does not find supporting evidence for the fact that inequality affects the propensity to cooperate.

So, what have we learned from section 1.1 and what needs to be explored further? In the next section the research questions and motivation for using the research methods will be presented for each of the research domains separately. Moreover, it provides an overview of the scientific significance and innovative aspects of the thesis.

1.2 Research Questions and Rationale for the Methodology

1.2.1 Economic Experiments: Microeconomic Foundation of Inequality

The empirical relationship between inequality and the growth rate of an economy is far from being well understood. Why is economic theory – as a discipline that has at least for 50 years attempted to do so – unable to explain the empirical relationship between inequality and growth in an unambiguous manner? Temple (1999), for example, highlights problems associated with running regressions on growth (measurement error, simultaneity, multicollinearity, etc.). These problems question the ability of the "macro data" to insulate different hypotheses on the causes of growth and inequality. Similarly, Barro (2000) attributes the ambiguous effect of inequality on growth to the fact that the predictions of the theories are canceling out each other.[9] However, aggregate macroeconomic data are not the only

[9] See section 1.1. for conflicting theoretical predictions of the effects of inequality on growth.

data available from which we can learn about the relationship between inequality and growth.

We can approach the question in a multi-disciplinary manner and incorporate arguments and empirical information developed in other areas of the social sciences, say behavioral economics. Before throwing away the "data", since they fail to deliver a clear message, these have to be reconsidered from different viewpoints. Excluding them at this point may be premature and could be harmful if they turn out to be important. By doing this exercise, the first part of the thesis hopes to identify the missing link between inequality and the propensity to cooperate and its implication on growth. This idea is also shared by Aghion *et al.* when they write:

> "A thorough test of the theories....requires other types of evidence,.....[such as] controlled experiments that test the micro-economic foundations of our analysis. In particular, experiments that increase the endowment of less well-off individuals and follow their subsequent economic decisions.....[which is assumed to have impact on the propensity to cooperate] by extension, upon economic growth." (Aghion *et al.* 1999, p.1655).

To this end, the first part of the thesis relies on building economic experiments. The experiment is motivated by the lack of detailed knowledge about the micro economic foundations of inequality and its consequences on economic performance. Experimental data are advantageous as the actual behavior of individuals can be elicited via monetary rewards in a controlled setup. Moreover, the results can be replicated.

Similar to Sadrieh and Verbon (2002), we allow for modelling economic reality as an interaction of individual agents who are not only pursuing their private interests but could also act according to social norms. However, most macroeconomic models do not enable us to observe the strategic interaction of the agents because it was assumed that the poor and rich work in isolation (e.g. Aghion and Bolton, 1997). In real life, production is essentially a group process: workers almost invariably work in firms or other social organizations. The experiment compares out of

equilibrium behavior by measuring the extent of cooperation in laboratory under different treatments. In general, our experiment enables us to explore whether the same level of inequality can affect cooperation behavior in different ways, depending on the circumstances under which it has historically emerged. The findings suggest that inequality alone doesn't affect the propensity to cooperate but rather perceived fairness of inequality plays a role.

Moreover, the literature also does not try to assess whether the observed ethnicity effect is confounded with income effects. Are the dimensions of race or homogeneity of income the dimensions predominantly driving the positive homogeneity-growth relationships? The discrimination that is found to exist towards other ethnic or racial groups may be due to the (low) incomes of subjects from discriminated groups, instead of being driven by purely racial or ethnic motives. In the second part of the thesis the effect of homogeneity in terms of both race and income will be addressed, where income inequality is found to be an important variable in generating trust and trustworthiness in a given society for a given racial composition.

In sum, experiments offer us an important implication i.e. the perceived inequality is an important element in influencing the propensity to cooperate. However, the economic experiments could not answer all the posed questions. For example, it is difficult to extrapolate results of economic experiments to macroeconomic policy. Moreover, experiments are not without their limitations. The observed behavior in the laboratory may not represent similar situations in practice i.e. there is the problem of external validity. For example, restrictions have to be made with respect to the complexity of the laboratory economy. This is because the experiments may become too costly. Extending the time horizon in the laboratory, would lead to a complex environment. Experiments quickly become too complicated to be understood within available time, given that subjects in the laboratory have relatively little time to learn the game and understand the consequences. Last but not least, economic experiments by default can not tell much about the size of the coefficients i.e. as experiments do not deal with magnitude of the effects.

One needs to take into account these shortcomings using an econometric model.

Empirically, in order to determine the quantitative magnitude of the impact of inequality on growth, one would normally apply standard econometric analysis that enables to draw some policy implications. That will be addressed in the third part of the thesis (Chapter 6).

1.2.2 Joint Determination of Inequality, Taxes and Growth

Moreover, the question as to how inequality affects growth is not well understood from the political economy channel. First, there are no conclusive empirical results for the political economy models; the prediction that higher income inequality leads to a higher level of redistributive taxation is not supported by empirical evidence. Perhaps, redistributive taxation may be limited by various kinds of incentive costs of taxation and the lobbying activity of high-income groups and various imperfections inherent in the political process that determine the tax system. Second, how inequality and growth are jointly determined in a dynamic political equilibrium is not well understood.

Last but not least, redistribution is not always bad for growth. The opposite might be true, i.e. in societies where financial development is weak, redistribution helps unskilled individuals as it enhances the opportunity to invest in human capital accumulation and in profitable projects. In fact the relation between growth and tax rate seems to be non-monotonic. Therefore, can we present a model that explains non-monotonic relations between inequality, growth and taxation? How does the pressure for redistribution change endogenously during the interaction of economic agents and the growth process over time?

The second part of the thesis (Chapter 4 and 5) attempts to develop a theoretical model that addresses the above posed questions. Most political economy equilibrium models of the types discussed so far offer an excellent insight into the phenomenon of redistribution. However, they are based on how a predetermined initial income or wealth distribution affects redistribution (growth) which ignores the joint determination of inequality, redistribution and growth. As Persson and Tabellini put it:

> To date, how income distribution and economic growth are jointly determined in political equilibrium is not very well understood (Persson and Tabellini,1994, p.618).

The theoretical model we develop aims to provide a unified dynamic theory, where redistribution has both growth enhancing and disincentive effects. Our contention is that the different arguments towards the effect of redistribution on growth are not mutually exclusive but rather complement one another. We provide a model of the dynamic forces leading to political outcomes and, consequently, the effects of these outcomes for economic growth. In particular, we stress the role of the dynamics of inequality as both a determinant and a result of political and economic processes. We address the issue by modelling the economic and political processes as intrinsically different but interacting domains. This part of the thesis does so via allowing the following modifications.

First, the theory relaxes the assumption that agents have identical endowments or preferences i.e. the so called representative-agent assumption. Instead, it relies on an Overlapping Generations (OLG) model where agents have different wealth levels, leading to difference in skills, income and political preferences. Majority voting models may not be a good representation of the political process and thus unsatisfactory as a positive theory of redistribution (Rodriguez 2000). In order to explain this, we abstract from using the median voter approach which centers on a time invariant distribution and instead we consider the phenomenon of expending resources in an attempt to influence political decision making on redistribution. So, we adopt the idea of lobbying as an investment in time, that is, we assume that members of both skilled and unskilled pressure groups have to decide on the allocation of time. Individuals divide their labour endowment between supplying labour to production or lobbying activities. It is shown that the optimal supply of labour and lobbying effort then leads to a condition, where the marginal benefit of lobbying equals the individual wage. If there happens to be an increase in technological progress, implying an increase in the wage of skilled workers, it will become worthwhile for the unskilled to undertake more lobbying activities and

supply less labour. This will lead to an increase of the tax that is used for intra-generational redistribution. This leads to an increase in the number of skilled workers. Since the political outcome depends not only on a political activity but also on group size, there exists a mechanism where taxes are blocked by opposing forces.

Second, for years it has been difficult to explain why interest groups emerge and collapse while trading with politicians. Existing models of political economy ignore the dynamic issues of the political process and focus on endogenous policy models with interest groups of a fixed size. This part of the thesis, however, does so by linking political decisions to economic variables rather than only to political settings. In particular, it deals with the dynamics of political choice and with how interest group strategies might change in such a setting. In effect, the group size is endogenous following the time of path redistribution and hence time variant.

Third, in Alesina and Rodrik (1994) and Persson and Tabellini (1994), the distribution of income is predetermined and remains constant. In reality growth itself affects income distribution. To analyze the dynamics of redistribution, economic theory must take into account not only the effects of policies on economic performance, but also how economic performance feeds back into the determination of political outcomes. Namely, political economy considerations must be integrated into dynamic macroeconomic models. The second part of the thesis takes this into account. It presents a theoretical model for analyzing the dynamics of human capital accumulation and inequality by introducing mechanisms of endogenous redistribution and technological progress into the model. The time path of inequality, taxes, political activity, human capital and growth towards its steady state value is illustrated via numerical simulations.

The model is also enriched by considering the possibility that very rich individuals pay contributions to the politicians in order to be exempted from paying taxes. It is motivated by the fact that pre-tax inequality may not always lead to a higher degree of redistribution. In effect, it might explain the failure of theoretical models to support a positive relationship between equality and redistribution observed in the data.

Recent political economic models (cf. Grossman and Helpman, 1994) handle the case of many agents with different preferences by considering a social planner (the government) maximizing a weighted sum of individuals and monetary contributions. In most earlier work, the government assigns the weights which is exogenously given on each type, say μ to the preference of aggregate welfare and $1-\mu$ to the preferences of bribes. The important feature of this chapter is that by merging the two literatures of political economy models, this part of the thesis is able to endogenize the weight the politician attaches to his/her constituents. We use a pressure group model of Becker (1984) type, that assumes active participation of potential voters in the form of lobbying activity to influence policies. Our model of the political process also includes a model of bribery, which serves as a guidance for our empirical work that we discuss in Chapter 7. This means how the political mechanism determines the μ in political economic equilibrium and how this decision in turn affects human capital accumulation and growth is analyzed in a dynamic setting.

The theoretical model developed in this thesis is able to examine the joint determination of inequality, taxation, human capital and economic growth to their multiple steady state values. Nevertheless, the theoretical model employed in part II of the thesis involves several feedbacks that are highly complex and hence, the dynamics is analytically intractable. A simulation of the model is helpful to illustrate the transitional dynamics and to highlight the ability of the model to reproduce the theoretical predictions. However, simulations are not without their problems either. Their output in fact is a numerical series where the input variables could be different from the real data used in the traditional econometric analysis. Usually, there is a high degree of freedom in defining initial values as well. In order to take into account these shortcomings, the third part of the thesis (Chapter 7) uses aggregate data to verify the theoretical predictions.

1.2.3 An Empirical Analysis

The third part of the thesis is mainly empirical i.e. econometric analyses in which aggregate data are employed. It tries to replicate the results achieved in Part I and Part II. Outcomes of economic experiments (mainly chapter 2), for example, attribute the failure of empirical studies to provide a consistent answer to the fact that the inequality measures do not accurately provide signals whether inequality is generated fairly or unfairly. Indeed, the standard measure of inequality, such as the Gini coefficient or quantile ratios, do not tell why the measured inequality has increased.

There is a general consensus that a shift in labor demand away from the unskilled and disadvantaged, in favour of the skilled and socially adaptable, is the main reason for the rise in inequality. Moreover, market forces are changing in ways that reward these high skills relatively more than they did in the past, thus strengthening the incentive for individuals to acquire these skills. A question arises whether inequality of outcomes is (as measured, for example, by incomes) really a problem? European Value Surveys in 36 countries asked respondents, "Would you say that it is fair if quicker secretaries are paid higher than others?" The mean response averaging across all countries, was that 83% of respondents thought it is fair.

Therefore, some might say that when inequality reflects the outcome of the market process, it is probably perceived as fair by citizens as people feel that they "deserve" it. For those who interpret inequality as a sign of opportunity or reward of productivity, it is difficult to accept that there are negative effects. If, however, inequality has emerged due to actions that are perceived as unfair, it is likely that people will feel others are getting something they don't deserve. For those that see inequality as a reflection of persistent disadvantage for a particular section of society, it is hard to see positive elements. Therefore, the concept of "perceived inequality" we adopt is similar to Alesina and Angeletos (2005), based upon the distinction between two types of inequality: "justifiable" inequality induced by variation in talent and effort, and "unjustifiable" inequality induced by variation

in corruption and rent seeking.

Deconstructing the concept of inequality (whether it is fairly or unfairly generated), which often underscores the relevance of exploring measures of perceived fairness, might not be easy. An obvious candidate for measuring fairness might be the European Value Survey or World Value Survey, containing questions related to fairness. However, few observations exist for earlier periods. Therefore, the perceived level of corruption in a country, compiled by Transparency International, is used as a proxy as to how individuals perceive their economic position is contaminated by unfair means i.e. corruption. By doing this exercise, this part of the thesis attempts to provide a consistent message on the effect of inequality on growth, in the short, medium and long run.

Moreover, the theoretical predictions generated from Part II are examined empirically in Chapter 7. As said already political economy models that rely extensively on the median voter theorem show that greater skewness in the distribution of income leads to more redistribution in democratic societies. High redistribution in turn generates disincentives for capital accumulation and growth. However, the evidence for a negative relationship between growth and redistribution is weak. In fact, the relation seems to be non-monotonic. Perotti (1996), for example, finds a positive relationship between redistribution and growth. The concern here is that whether we can verify the non-monotonic relations between redistributive measures and growth rates. If there exist a growth maximizing redistribution level, why do some countries redistribute less than others? Can the existence of a wealth bias in the political process explain differences in redistribution measures across countries?

1.3 Outline of the chapters

The above questions guide us to seek alternative ways of understanding the relationship between inequality and growth. The following parts of the thesis give different methods to address the questions posed above. Table 1.1 presents a general overview of the research design, together with five different research methods (survey, experiments, secondary data, numerical methods and model driven), which

Table 1.1: Schematic Overview of the Research Design

Part	Method	Redistribution	Data analysis
I	Experiments	Exogenous/Endogenous	Non Parametric FET, MWT
I	Experiments[1]	Endogenous	Regression Analysis (TM)
II	Theory	Endogenous	Numerical Methods
II	Theory	Endogenous	——
III	Econometric	Endogenous	Regression Analysis (OLS, 3SLS and FE)

[1]Survey questions were asked after the experiment is conducted. FET = Fisher Exact Test; MWT=Mann-Whitney Test; FE = Fixed Effects; TM=Tobit Model; OLS= Ordinary Least Squares, 3SLS = Three Stage Least Squares.

contribute in a specific way to knowledge building about the relationship between inequality and growth.

The remainder of this thesis consists of six chapters that deal with the issues and questions raised above. Chapters 2 and 3 focus on economic experiments and chapters 4 and 5 rely on theoretical and economic modelling. The last chapter uses some macro data to replicate the predictions gained in Part I and Part II. This section presents an outline of the chapters, which can be read independently.

Chapter 2 studies, experimentally, the effect of income inequality on growth rates of economies. It does so by developing a model where output depends on initial wealth and endogenous effort. In the experimental set-up individuals start off with an endowment of wealth that has to be invested. The invested wealth can generate output which depends on one's own effort and on the efforts of other group members. If no one contributes, the wealth of each individual vanishes. Effort levels thus have a public-good character. The focus of chapter 2 is on the question whether inequality leads to decreased effort contributions to public goods and thereby economic growth. To this end, we use experiments in which groups of subjects are matched to be a "society". Every member of each of these experimental societies anonymously and independently chooses whether to provide a low or a high level of "effort" for the social production. If everyone provides a high level of effort, then the social output is maximized. But, since providing high effort is costly to the individual, each member of the society could also prefer to provide only a low

level of effort, while hoping that others should provide high effort levels. Thus, the situation is that of a social dilemma. We compare experimental societies with a high degree of income inequality to experimental societies with a low degree of income inequality using two variants of wealth distribution (exogenous and endogenous). One in which distribution is exogenous (property rights assigned by a random draw) and the other is endogenous i.e. decided by a member of the society. The question we ask is whether the amount of effort that is provided depends on the degree of inequality and/or on its genesis (whether it is generated randomly or by a member of a society). We find a significant difference on the propensity to cooperate when the member of a society chooses a high degree of inequality. However, when inequality is generated by random draw, we do not find any significant differences.

While chapter 2 examines only one dimension of heterogeneity (income inequality) on the propensity to cooperate, chapter 3 takes the research project one step forward. It is motivated by the fact that in the literature some authors claim that it is not only heterogeneity in income but also racial fragmentation or ethnicity that contributes to the propensity to cooperate. Therefore, chapter 3 aims to disentangle the two main division lines that may exist in heterogeneous societies, i.e. the racial or ethnic and the income divisions. In order to answer this question, the experiment is conducted in South Africa, a country where differences along both dimensions are present. The treatments involved the manipulation of the information available to the subjects about their counterparts.

We find that individuals are strategic actors whose trusting behavior is conditional on the decision context including the characteristics of a partner. Our central result is that subjects from different racial groups trust each other less but only if there is a difference in the position of their income. Using the trust game, we examined a systematic mistrust of low-income blacks against high-income whites. Moreover, we also find white participants from low incomes families to exhibit less trust against high-income blacks. Nevertheless, no significant behavioral difference was found when subjects come from the same pool of income distribution. We also examined trust level within the same race but different income groups. For example, participants from high-income blacks trust low-income blacks less but trust

high-income whites more. Surprisingly, chapter 3 finds no pure racial effect; rather we find that income inequality adds envy to racial difference. Moreover, instead of manipulating income inequality artificially through experimental institutions or incentives, as done in chapter 2, it gathers information on the actual wealth and other social and economic characteristics of the participants. It explores the possible relations between background characteristics and the observed experimental behavior. We analyzed respondent answers to questions whether resources are generated fairly or not as a means to gauge the effects of perceptions on inequality. Our findings support the importance of the way people perceive inequality and suggest that it may be even more important than income inequality *per se*. The result shows that the propensity to reciprocate is higher when members of a society think the generation of wealth in South Africa is fairly determined.

In chapter 2 and 3, redistribution takes the form of a transfer between the individuals but in reality redistribution is governed by the political process. Chapter 4 and 5 look at the redistributive process in a democracy when government activities are financed through factor income taxation.

Chapter 4 considers a model, in which taxes levied on wage income could have a growth enhancing effect. On the economic side, we develop a two-sector endogenous growth model where growth is driven by human capital, and capital markets are missing. In such an economy, investment in human capital tends to be inefficiently low and redistribution may have significant effects on growth. Growth is mainly determined by skilled people and the knowledge production develops because of learning by doing in the two sectors. Persistence in inequality could prevail when redistribution is blocked, creating multiple steady state equilibria.

We use a pressure group model where the political outcome depends on political activity and group size. To gain political power or influence on the size of the transfer, each individual represented by a group (skilled vs. unskilled) invests time in various political activities. To put the hypothesis in a very simple fashion, groups whose members have a low marginal product are more politically active i.e. enforce the opportunity cost effect. These differences are the result of differences in the balance between the costs and benefits of lobbying i.e. cost-benefit effects.

On the other hand, when the political activity of unskilled workers increases, the dynamics of redistribution may cause the number of unskilled to shrink and the group of skilled workers to grow. If group size effects are important, that is, if the relative size of a lobby group matters for influencing government policy decisions, this may lead to a countervailing power of the skilled lobby merely for their number. As a result of these two opposing forces persistence in inequality may prevail when redistribution is blocked.

Chapter 4 offers a unifying approach between political economy and credit market imperfections approach. This is because a credit constrained individual could be able to cover the cost of education if lifted via redistribution. Note that redistribution here increases efficiency as well as equity. Since there are learning-by-doing effects, raising the level of output would improve the growth rate as well. On the contrary, an increase in redistribution is also associated with a reduction in the effective labor supply. This inefficiency will reduce the level of output and the growth rate as well, because lower output depresses learning by doing. A non-monotonic relationship prevails between long-run growth and the tax rate: for low values of the tax rate more redistribution goes along with higher growth, for high tax rates a further increase of redistribution goes along with lower growth. Similarly, this chapter shows that the relation between education and growth is non-monotonic.

In order to quantify the strength of the results found in chapter 4, this chapter investigates the full dynamic adjustment process by numerical simulation experiments. We show that the equilibrium that is actually realized in the long-run is dependent on the initial distribution of wealth. In particular, we illustrate that effective redistribution of wealth can promote growth. In the examples, we show that higher long-run growth is accompanied by a lower tax rate, i.e. less redistribution.

In chapter 5, the model from chapter 4 is enriched by allowing for the possibility that very rich individuals pay contributions to the politicians in order to be exempted from paying taxes. This chapter presents a model allowing one to analyze the joint determination of inequality, taxes, human capital and growth. We consider the political economy of redistribution between three income groups in a dynamic economy. The paper seeks to explain the effect of corruptibility (exemptions) and

lobby activity on policy outcomes. The effective pressure of a lobby group not only its political activity, but also on the amount of private wealth (rather than only wage income) its members possess. This makes sense since in reality it is indeed the case that money plays a role in influencing government decision making.

Chapter 5 presents a model where politicians maximize political support by mixing popular policies with campaign spending. Campaign contributions are offered by individuals who are wealthy people with greater incentives and opportunities to use bribery (both grand political corruption and bureaucratic corruption) and fraud to escape taxation. The effective pressure of lobbying depends not only on the economic position of its members but also on political activity. The unskilled are less likely to be exempted, as getting exemptions demands financial contribution. The unskilled group is politically active, however, by investing time in political activities such as strikes, working on campaigns, writing to members of parliament, lockouts etcetera. In line with this, we assume that unskilled individuals invest time to influence the political outcome, i.e. the level of redistribution.

We incorporate this politico-economic game in a standard growth model, in which the economic environment evolves dynamically due to the process of endogenous, human capital driven, technical change. Technological change that widens the wage gap between skilled and unskilled will result in a decrease in the tax base as more people have an incentive to ask for exemption. The erosion in the tax base can lead to a lower tax revenue and consequently lowers the per capita transfer assumed to have a direct link with human capital accumulation and growth.

Part III is mainly an empirical analysis. While most studies concentrate on cross-section and panel aggregate data analyses to explore the effect of inequality on growth, chapter 6 takes into account the behavioral insights of the microeconomic foundations of inequality. Experimental evidence shows that the role of perceived inequality matters more than inequality per se. These results suggest that one should be careful in empirical testing. A simple linear regression of an inequality measure can cause specification bias. Chapter 6 considers an empirical work that incorporates the perception of individuals to the degree of inequality, i.e. the level of corruption a country has is used as a proxy as to how individu-

als perceive the generation of wealth inequality. Contrary to previous findings on the inequality-growth regressions, this chapter delivers a consistent message across the time dimension. Regressing on 20 or more, 10 and 5 years averages of growth rates on the interaction term between corruption and inequality indicators yields negative effects on economies growth rates. That is when inequality reflects the outcome of market process, which is probably perceived as fair by citizens, inequality does not have a negative effect on growth, but inequality that is perceived as unfair might have a negative effect on growth.

Furthermore, chapter 7 addresses the empirical falsification of the political economy approaches i.e. the fact that income inequality does not necessarily lead to a higher redistributive taxation. Chapter 7 provides empirical evidence for the importance of the effect of inequality and wealth bias in a political system for the evolution of Tax/GDP ratio, human capital and economic growth. A panel analysis of 53 countries from 1980 to 1999 shows that there is a non-monotonic relationship between growth and redistributive measures. Moreover, it is shown that, consistent with the theoretical predictions of the results attained in Part II, the relation between education and growth is found to be non-linear.

Part I Economic Experiments

Chapter 2

Malevolent Dictators and Economic Growth

2.1 Introduction

As said in Chapter 1, so far the evidence on the relationship between inequality and growth is mostly based on cross-section analyses of macro data on countries. Although this kind of studies can give useful insights in the cross-country relationship, they are not able to test the microeconomic foundation of the theoretical analyses (see also Aghion *et al.* 1999, on this issue).

Experimental investigations, however, are able to generate these tests, as controlled variation can be used to infer the effect of a change in inequality on individual behavior, and, in a dynamic setting, on growth. The number of studies dedicated to this issue is very scarce as yet. Moreover, so far no clear experimental evidence has established the hypothesized negative effect of inequality on cooperation and trust. In fact, experiments by Chan *et al.* (1996, 1999) report a contradicting result. They find a small but positive effect of inequality on voluntary contributions to public goods (especially by the "poor"), which indicates a (partially) positive correlation between inequality and cooperation. Sadrieh and Verbon (2002) conducted experiments in which 3-person groups with rich and poor individuals could provide efforts to increase the group's social product. The groups

differed in the degree of inequality between the group members. They observed a substantial amount of cooperation, and as a consequence significantly more growth than in equilibrium. However, inequality did not appear to have an effect on the propensity to cooperate.

One way to interpret the neutrality finding is that if inequality is determined exogenously (by the experimenter in our case) the degree of inequality does not affect the way individuals in a group perceive each other's willingness to cooperate. However, determining inequality that way does not always do justice to the way inequality has arisen historically in societies. Inequality may have emerged from "unfair" actions by leading groups or individuals in a society (e.g. it may be the result of economic discrimination of a minority, or due to corruption among leading factions), but it may also be the result of "neutral" market forces. In the latter case, the income distribution is not perceived to be manipulated by deliberate action of the privileged, and it is plausible to assume that especially "poor" individuals then exhibit a higher willingness to contribute to a common goal than if inequality is established by unfair methods of the powerful.

This observation leads us to the role intentions might play in the actions of individuals. Do fair-minded people respond to intentions behind other individuals' actions or are their actions merely triggered by the outcomes of these actions? Recently, new theories have been formulated that propose utility functions incorporating the role of fairness intentions (Rabin, 1993; Dufwenberg and Kirchsteiger, 1998). These models assume that people are motivated by others' intentions, and not just by others' actions. So, if some actions, though possibly leading to adverse effects, could not be avoided because of the lack of alternative options, adversely affected individuals might refrain from attributing unfair intentions behind these actions. As a result, they might not consider these actions as unfair treatment, and remain willing to be cooperative. On the other hand, if unfair intentions are suspected behind these same actions the response might be completely different. As a result, if the attribution of fairness intentions determines behavior in societies, a given degree of inequality in societies can lead to widely different behavior, and thus have different growth enhancing consequences, depending on how actions are

perceived.

Although the idea of fairness intentions has attracted a lot of theoretical attention, experimental studies demonstrating the relevance of fairness intentions have been scarce to date. Blount (1995) compared second mover rejections in a standard ultimatum game in which the first mover's choice was generated by a random device with rejections instead of by a subject that would receive the payoff. She found lower rejections in the random treatment, although the difference was not statistically significant. Falk, Fehr and Fischbacher (2000) use the so-called moonlighting game in which a proposer has the option to give tokens to a second person (the responder) or to take away tokens from the responder. After the proposer's move the responder can react by choosing an action which has negative (sanction) or positive (reward) consequences for the proposer. They demonstrate that if responders to a gift are confronted with a proposal from a randomized machine they will react neither in a positive reciprocal way nor in a negative reciprocal way. The individuals' behavior is remarkably different, however, if they are confronted with the proposals of "real people". In that case, a proposal to take away tokens is reacted upon by the responder by imposing large sanctions onto the proposer, while gifts are rewarded with actions that benefit the proposer. Cox (2002) and Cox and Deck (2002) use the trust and the investment game to examine the effect of perceived intentions. In one of their treatments second-movers in an investment game get proposals from first movers in another investment, and they have to decide on the amount returned to "first movers" who did not propose an amount of money at all. In this treatment the amount returned is significantly greater than in the treatment where the second movers had to return on the same amounts of money proposed by 'real' first movers. These studies suggest that reciprocal or cooperative behavior can be intentions driven (cf. Charness, 1966; Bolton *et al.* 1998).

The model we introduce allows us to deduce whether fairness intentions can play a part in the relationship between inequality and growth. As in Sadrieh and Verbon (2002) we use a dynamic 3-persons 2-period game to experimentally examine the effects of inequality. One individual in the 3-person group is "rich" and

two individuals are "poor". In each team the one rich and the two poor individuals cooperate to produce a social product that leads to individual earnings which are proportional to individual endowments. All payoffs are derived from the social product, so that we concentrate on the part of the economic activity that requires the cooperation of all individuals. In this context, being poor means having a smaller share of the property rights to the social output than the rich. Since the provision of effort to the production process is voluntary, but costly, and since the social product depends on total provided effort, we effectively have a dynamic public good game with voluntary contributions. Apart from a varying degree of inequality, a treatment is introduced where the rich individual has to decide before the individuals start contributing whether a "fair" or an "unfair" distribution will hold at the beginning of the game. If perceived fairness intentions are relevant for behavior, this treatment should have a determining effect on the relationship between inequality and growth as well.

We propose modelling economic reality as an interaction of individual agents where the degree of inequality has a neutral effect on growth. Observe that the different views on the relationship between growth and income inequality from chapter 1, can to a certain degree, be traced back to a different view on the relevance of physical capital as opposed to human capital in driving economic growth. When the financial markets are binding and economic growth is crucially driven by physical capital accumulation i.e. investment demands huge capital stock, inequality fosters growth as high-income people are assumed to save disproportionaly more. In contrast, inequality is bad for growth when driven by human capital accumulation and financial capital is binding. This is essentially caused by the fact that there are diminishing returns to investing in human capital accumulation of every selective group of rich people and, moreover, the poor are unable to invest in education.

Now suppose, the economy demands the financial participation of all individuals and labor is homogeneous, but individuals are only different with respect to their initial capital holdings. The aggregate output is a function of aggregate capital and individuals' efforts into the production process. The latter depend on the benefit of

effort, which is proportional to individuals' capital endowment and on the cost of effort which is proportional to the total capital accumulated in the economy. There is inequality in the model, because the individual earnings from total output are proportional to individual endowments, i.e. they are greater for the rich than for the poor. Then it is straightforward to expect inequality to be neutral to economic growth. In other words, a mean preserving redistribution has a neutral impact on the provision of aggregate labour supply.

We examine a low inequality and a high inequality setting. In one treatment the rich individuals choose for their group between the two settings before individuals start acting within their team and in the other treatment the endowments are set prior to the experiment. In the two periods of the game, subjects can choose one of two actions: Nash, or cooperation. In each period, after the choices of all group members have become public, the group members are given the opportunity to destroy all the returns on the provided effort in that period. If one member chooses this destruction option, all group members see their returns on their efforts in that period vanish. The destruction action is strictly payoff dominated by the Nash action at any point of the game. Nevertheless, the destruction action may be attractive to some subjects, because it reduces the payoffs of all players to below equilibrium levels and, thus, reduces the degree of income inequality. Moreover, individuals might be motivated to use this option if they feel treated unfairly by the others, and want to punish in return. Note that although the monetary payoff of choosing destruction is always smaller than that of choosing a different strategy, the structure of the payoffs makes the cost of sabotage smaller for the poor than for the rich

The strategy combination consisting of Nash action choices by all players in all periods is the sub-game perfect equilibrium of the dynamic game (and thus, also the sub-game perfect equilibrium at both stages in the game). The cooperation action is also costly, but – in contrast to destruction – it increases the payoffs of the others. As in a prisoner's dilemma game, choosing the cooperation action may be attractive to subjects, because the highest total payoffs are achieved when all players cooperate in all rounds.

We find that the experimental observations overwhelmingly support the Nash as opposed to the Cooperative solution in only one treatment. However, while the Nash solution is much better supported in a dichotomous comparison between the two, the experimental results typically display some degree of slippage in the direction of cooperation. We observe a substantial amount of cooperation in our experiment. Instead of choosing the sabotage action, many of the subjects choose to cooperate. The convergence towards the Nash solution was weaker in other treatments.

We proceed as follows. In the next section we present a theoretical model and discuss some of the theoretical implications. In section 2.3, we describe the experimental parameterization and procedures. Section 2.4 contains the results and section 2.5 concludes.

2.2 The Model

We assume there are n individuals $i = 1, ..., n$ with capital endowments, $w_t^i > 0$. All capital is productive, and individuals can generate a return on the total capital available by exerting effort l_t^i $(i = 1, ..., n)$. Effort can be interpreted as the time or attention an individual contributes to the production process. All individual's efforts are perfect substitutes in generating returns on capital, i.e. the marginal productivity of effort is the same for every individual. The efforts l_t^i that are exerted by the individuals $(i = 1, ..., n)$ are aggregated to form total labor input in production. The production function $f(w_t, l_t)$ combines the available total endowment with the efforts that are exerted by the individuals $i = 1, ..., n$

$$f(\omega_t, l_t) = \sum_{j=1}^{n} l_t^j \sum_{j=1}^{n} \omega_t^j \tag{2.1}$$

The individual's effort involves a cost (e.g. a decrease in utility due to the loss of leisure) that is borne by the individual himself. As in Aghion *et al.* (1999) the cost incurred by individual i is proportional to total capital accumulated in the economy and the squared individual efforts, $c(w_t, l_t^i) = \frac{(l_t^i)^2 \sum_{j=1}^{n} w_t^j}{2}$. The payoff of

individual i at the end of a period is equal to his share $\frac{w_t^i}{\sum_{j=1}^{n} w_t^j}$ of the total product minus effort cost:

$$\pi_t^i = \frac{w_t^i}{\sum_{j=1}^{n} w_t^j} f\left(w_t, l_t\right) - c(w_t, l_t^i) = w_i \sum_{j=1}^{n} l_t^j - \frac{(l_t^i)^2 \sum_{j=1}^{n} w_t^j}{2} \tag{2.2}$$

Notice that the individual effort choices have the character of voluntary contributions to a public good: All members of the society gain when an individual exerts productive effort, but the cost of exerting the effort is borne by the individual alone. Moreover, if no individual contributes to the generation of a return on investment (i.e. $l_j = 0,\ j = 1, ...n$) everyone's gross and net return will be zero. It can readily be calculated that for any vector of contributions by the other individuals, the Nash equilibrium strategy of player i is:

$$l_{t,N}^i = \frac{w_t^i}{\sum_{j=1}^{n} w_t^j} \tag{2.3}$$

Notice that, according to equation (2.3), it will always be optimal to put in efforts contribute towards the public good, i.e. $l_{t,N}^i > 0$, irrespective of the contributions efforts provided by the others. Thus, the Nash equilibrium will not be at a corner of the action space. In our experiment, subjects had to choose between playing Nash or playing cooperatively. Regarding the latter, we can formulate a social-welfare function, and maximize this function with respect to individual efforts. As is well known, the choice of a social-welfare function depends on how society ranks subjects' utilities, and thus depends on subjective judgements. This left it up to us to choose a cooperative structure, so we picked a structure that was simple to implement experimentally and led to substantial payoff differences compared to Nash. The following specification, in which a constant amount of effort (0.25) is added to every player's Nash equilibrium effort, satisfied these criteria:

$$l_{t,C}^i = l_{t,N}^i + 0.25 \tag{2.4}$$

For the economy, the growth rate could be observed from the angle of the social production function where all payoffs are derived. In our model, all payoffs are derived from a social production function (i.e. the part of the economic activity that requires the cooperation of all individuals). Next period's endowment is the discounted sum of this period's endowment and payoff that is defined by (2.2), i.e. $w^i_{t+1} = \rho(\pi^i_t + w^i_t)$ where ρ is a discount factor. (For the experiment, we set $\rho = 2/3$). In the next period, with the updated wealth levels, the individual again must decide whether to play Nash, as defined by (2.3), or to play cooperatively, as defined by (2.4). The payoff of the new period is again determined by (2.1), but now for the updated values of the individual endowments. The total payoff of each individual is obtained by adding all period payoffs. The total payoff, thus, indicates the absolute growth an individual has realized on his initial endowment. The individual rate of growth can then be obtained by simply dividing the total payoff by the initial endowment.

After each period of the game, every individual has the option to destroy the entire current production of the economy. If destruction is chosen by any single individual, the payoffs of all individuals for the current round are zero and the endowments retain the original previous period size. In particular, if in two periods at least one member chooses the destruction option, perfect income equality is established, because the total payoff of every individual is zero.

2.3 Experimental Conditions and Procedures

The dynamic public goods game of effort provision described in the previous section was played in four experimental conditions. In every condition, an observation consisted of 3 players (called "an economy" in the following) with a total endowment of 300. In the low inequality setting, the rich had an endowment of 120, while the endowment of the poor was 90. In the high inequality setting, the endowments were 220 for the rich and 40 for the poor. In each session of the nature treatment, the experimenter determined one of the two possible distributions of endowments and informed the subjects before the game started. In the dictator treatment,

Table 2.1: Experimental Conditions

Treatment	Distribution	Gini	Number of Subjects
NaLo	by nature	Low(0.10)	21
NaHi	by nature	High(0.60)	24
DicLo	by dictator	Low(0.10)	24
DicHi	by dictator	High(0.60)	24

the experimenter informed the subjects that the rich individual will choose one of the two possible distributions before the game starts. After this choice was made the subjects were informed on the chosen distribution of endowments and the game started. This method of determining the initial endowments was the only difference between the treatments. Combining the method of distribution selection (nature vs. dictator) with the two possible outcomes (low inequality vs. high inequality) gives us the four experimental conditions NatLo, NatHi, DicLo, DicHi that are summarized in Table 2.1.

In all conditions, a two-period version of the dynamic public goods game of effort provision was played. In each period, players first chose their effort levels. They could choose to act cooperatively or to free-ride (i.e. play Nash equilibrium strategy). After all effort choices were made, subjects received feedback on all choices and payoff consequences in their economy. Then, each subject was given the opportunity to destroy the period's payoffs of all individuals in the economy (including their own payoff). In the second period of the game, the same decisions had to be taken. After the second period had been completed, subjects received their final payoffs. All actions were presented to the subjects in neutral terms: the free-riding and cooperative actions were called "A" and "B," respectively, and the payoff destruction action was called "reset."

All sessions took place at the CentERlab, at Tilburg University. The subjects were student volunteers that were hired via public recruitment on campus. Most of them were first year students in economics, business, and social sciences. Upon entering the laboratory, subjects were asked to draw a card from a covered deck. The randomly drawn card determined the table number at which they were seated.

The matching of the tables into economies and the roles of the players had been randomly determined before the experiment started.

The game was extensively explained to the subjects. After subjects had read the instructions (reproduced in Appendix A), they were asked to answer two guided practice questions that tested their understanding of the game. All subjects successfully solved the control questions. In total, 93 subjects (forming 31 economies) participated in the experiment. The distribution of economies over the treatments is given in Table 2.1. Incidentally, exactly one half of the rich subjects in the dictator treatment opted for the low inequality and one half opted for the high inequality distribution. Each subject participated only in one session. All sessions were held in May, June, and September 2002.

The experiment was run with paper and pencil. Students were seated in cubicles and were asked not to communicate. The payoff information was presented to subjects in tables (see Appendix B). The tables were organized so that each subject saw his/her own payoffs in the first column and the payoffs of the other players in the other two columns. Using the tables, the subjects could quickly "look forward" through both periods of the dynamic game.

Subjects did not know the identity of the other subjects in their economy, but they were fully informed of the contribution history in their economy. No explicit time limit was given to subjects. Nevertheless, the duration of no session exceeded the two hours that had been announced on the posters. The average duration of a session was about one hour and twenty minutes. At the end of the experiment, subjects received a monetary payment consisting of a show-up fee of 3 Euro plus the experimental payoff that was converted at a rate of €20 cents per point. Payments to the subjects, including show-up fee, ranged from €4 to €44.6, with an average of €10.10 (€1 is exchanged at the rate of about $1 at the time).

2.4 Experimental Results

Table 2.2 contains information on the individual choices regarding cooperative effort and destruction in both periods of the game. In the first part of the table, the

cooperative effort choices of rich and poor individuals are given for the first period.

We first check whether the neutrality result found by Sadrieh and Verbon (2002) is replicated, i.e. whether the inclination to cooperate by rich and poor individuals is neutral to the degree of inequality in the nature treatment. According to Table 2.2, in the nature treatment, 3 out of 7 low inequality economies show cooperative effort choices by the rich, while cooperation is exhibited for the high inequality economies in 5 out of 8 cases. This small difference obviously is not statistically significant. Likewise, the difference in cooperative efforts provided by the poor (5 out of 14 in NatLo and 7 out of 16 in NatHi economies) is not significantly different. This gives support to the finding that inequality – when it emerges from a fair, but random process – is neutral and does not have any growth-enhancing or growth-decreasing effects. This leads to our first result:

Result 1 : Inequality given by nature (a fair,but random process) does not have an effect on the level of cooperation by rich and poor individuals.

Let us now turn to the dictator treatment. Remember that in that case the rich individual determines which distribution should be put in place before effort choices are made. Notice from Table 2.2 that the rich are not much affected by their own choice of inequality: Only 2 of the 8 rich, who choose low inequality as dictators, also choose the cooperative action. This ratio is not significantly different from the ratio of one out of the 8 rich dictators, who chooses high inequality and cooperation. The behavior of the poor, however, is significantly affected by the distribution that the dictator chooses: While 10 of 16 poor provide cooperatively high effort, when low inequality has been chosen, only 2 of 16 cooperate, when high inequality has been chosen. This difference in the number of cooperative plays is highly significant (0.01; two-tailed). Thus, if the rich dictator chooses low inequality, the poor reciprocate by putting more effort into generating returns on the capital stock. Hence, if the poor and powerless in an economy know that those who are in power have actively reduced the inequality, then they provide more effort to the benefit of the entire economy. On the other hand, dictators choosing

high inequality seem to signal a self-serving attitude that induces a large majority of the poor to behave non-cooperatively. This is laid down in our second result:

Result 2 : In the dictator treatment the poor will provide more cooperative effort under low inequality than under high inequality.

A key issue in this paper is the question whether the way inequality arises has an effect on individual behavior. We can analyze this issue by comparing the effort choices in the dictator settings to the effort choices in the corresponding nature settings. Comparing across columns, Table 2.2 shows that under low inequality, the behavior of the rich is the same, no matter whether the distribution was randomly selected or was an explicit own choice: 3 of 7 rich in NatLo and 2 of 8 rich in DicLo provide cooperative efforts. In the case of high inequality, however, the rich are significantly ($p \leq 0.10$; two-tailed) more cooperative in NatHi, where the income distribution is set by nature (5 out of 8), than in DicHi, where they chose high inequality distribution themselves (1 out of 8). But, of course, there may be a selection bias here, because the rich, who choose high inequality, can be expected to be less cooperative.

For the poor, the picture is even clearer. Under high inequality, the poor are significantly less cooperative ($p \leq 0.05$; two-tailed), if the distribution has come about by willful choice of the rich dictator than if the distribution has been determined by nature: 2 of 16 poor cooperate in DicHi, while 7 of 16 do so in NatHi. Under low inequality we find the reverse: the poor are significantly ($p \leq 0.10$; two-tailed) more cooperative when the rich choose the low inequality distribution than when it is put in place by nature (10 of 16 poor cooperate in DicLo, but only 5 of 14 poor cooperate in NatLo). This leads to our third result:

Result 3*a* : The poor are more cooperative when low inequality has been set by the dictator instead of by nature.

Table 2.2: Individual choices in the first and second periods

Treatments	Rich Dictator	Rich Nature	Rich Fisher[b)]	Poor Dictator	Poor Nature	Poor Fisher[b)]
1. First period cooperative effort choices[a)]						
Low Inequality	2 (0.25)	3 (0.43)	0.33	10 (0.63)	5 (0.36)	0.10
High Inequality	1 (0.13)	5 (0.63)	0.06	2 (0.13)	7 (0.44)	0.05
Fisher	0.40	0.40		0.00	0.27	
2. First period destruction choices						
Low Inequality	0 (0.00)	0 (0.00)		0 (0.00)	0 (0.00)	
High Inequality	0 (0.00)	1 (0.13)		1 (0.06)	1 (0.06)	
3. Second period cooperative effort choices						
Low Inequality	2 (0.25)	1 (0.14)	0.43	3 (0.19)	4 (0.29)	0.28
High Inequality	1 (0.13)	3 (0.38)	0.25	1 (0.06)	6 (0.38)	0.04
Fisher	0.40	0.29		0.25	0.27	
4. Second period destruction choices						
Low Inequality	1 (0.13)	0 (0.00)		1 (0.06)	1 (0.07)	
High Inequality	0 (0.00)	0 (0.00)		2 (0.13)	1 (0.06)	
Fisher						
5. Pay-off Points						
Low Inequality	73.57	77.50		55.06	60.50	
High Inequality	43.13	86.13		21.94	27.50	

[a)] The entries indicate the frequency of cooperative effort choices (sections 1 and 3) or destruction choices .(sections 2 and 4) The relative frequencies are given in parentheses. Section 5 indicates average total payoff. [b)] "Fisher" stands for the Fisher's exact probability test for two independent samples. The entries in the "Fisher" columns (rows) indicate the two-tailed error probability for rejecting the Null hypothesis (H_0= no treatm -ent differences). $p \leq 0.10$ is considered to indicate significant differences.

Result 3*b* : The poor are less cooperative when high inequality has been set by the dictator instead of by nature.

Notice that result 3*b* survives in the second period, but result 3a does not. As can be seen in the third part of Table 2.2, the case of poor in the DicLo treatment is the only case in which the general level of cooperation actually changes dramatically in the second period. In all other cases, we observe about the same level of cooperation in the second period as we had observed in the first period. Thus, we have no indication of a general "end effect" (i.e. increased free-riding at the end of a finitely repeated game). The negative effect of a deliberate choice of high inequality on the poor players' willingness to cooperate is so strong that result 3b persists in the second period at the same significance level as in the first: the poor in DicHi economies exert significantly lower cooperative effort than in NatHi economies, both in the first and in the second period. In contrast, the positive effect of a deliberate choice of low inequality on the poor players' propensity to be cooperative is not strong enough to influence behavior in both periods: the frequency of cooperation by poor in DicLo is significantly greater than in NatLo in the first period, but drops to the same level in the second period.

Result 3 makes clear that poor individuals reciprocate the "kind" act of a dictator choosing low inequality by exerting high productive efforts, but punish the "unkind" act of choosing high inequality by exerting low productive efforts. Note that the "punishment" by providing uncooperative efforts is not costly to the punisher, because it is the best response strategy. The destruction option that all individuals in the economy have at the end of each period provides a quite different – and very costly – punishment possibility. If any individual chooses this option, the current period payoffs will be lost for all individuals. From the second part of Table 2.2 it is clear that this option is used rarely. Only 3 of the 93 individuals use this option in the first period and they are dispersed over all treatments.

Notice from the fourth part of Table 2.2, that 1 rich and 5 poor individuals choose to destroy the returns of the second period. Obviously, destruction in this

stage has no "educational" effect anymore, but it may be used as punishment, because it affects the final payoffs. Apparently, almost all rich individuals choose to safeguard the payoff that they have generated, while some of the poor individuals care less for their final payoffs and remain willing to punish others. Finally, it seems interesting that in three of the five DicHi economies, in which one of the subjects chooses the cooperative effort level, a destruction of the returns occurs. Apparently, when the dictator opts for high inequality, cooperation frequently is followed by destruction, because cooperation by one player tends to stay an isolated act.

Table 2.3. condenses the data to two-period observations on efforts at the level of the economies. The columns of the table give information on the first-period choice of the rich, and the two poor individuals, respectively, indicated by A (B) for the Nash- (cooperative) action. The rows give the second-period choices. In the cells the number of observations are given for each treatment with the four treatments grouped as in Table 2.2. Whether a destruction of the returns has taken place in a period is indicated by a suffix 1p (when a poor individual has chosen to destroy in the first period), 1r (a rich individual destroys in the first period) or 2p or 2r.

From the table, we learn that in more than half of the economies (17 out of 31) the rich individuals are uncooperative in both periods. The two poor players are uncooperative in both periods in 9 economies, so that in 22 economies one poor individual is cooperative in at least one period. Loosely speaking, the general picture is that the players are cooperative half of the time. This conforms to what is commonly found in dynamic public goods game. Another typical observation that we also find is the existence of an end effect: while in 23 out of 31 economies, at least, one other player in the economy behaves cooperatively in the first period, 15 economies end up with all players choosing Nash actions in the second period.

The table confirms what we have learned above, i.e. that if rich individuals opt for low inequality in the endogenous treatment, the poor reciprocate by exerting cooperative efforts: under DicLo at least one poor individual plays cooperatively in the first period in 6 out of 8 economies. If the rich individuals intentionally decide on high inequality, however, in 5 (out of 8) economies no single individual

Table 2.3: Observations on the economy level

		First Period Decisions				
Second Period decisions		AAA	ABA/ AAB/ ABB	BAA	BBA/BAB BBB	Row Totals
		Dic/Nat	Dic/Nat	Dic/Nat	Dic/Nat	Dic/Nat
AAA	Equal	1(0)	3(1)	0(1)	0(0)	4(2)
	Unequal	3(0)	$2^{2P}(1)$	$1^{1P}(1)^{1R}$	0(1)	6(3)
ABA/ AAB/	Equal	$0(1)^{2P}$	$1^{2P}(2)$	1(0)	0(1)	2(4)
ABB	Unequal	$1^{2P}(0)$	0(1)	0(0)	$0(1)^{2P}$	1(2)
BAA	Equal	0(0)	0(0)	0(1)	$1^{2P}(0)$	1(1)
	Unequal	1(0)	0(0)	0(0)	0(0)	1(0)
BBA/BAB	Equal	0(0)	1(0)	0(0)	0(0)	1(0)
BBB	Unequal	0(1)	0(0)	0(0)	$0(2)^{1P}$	0(3)
Columns	Equal	1(1)	5(3)	1(2)	1(1)	8(7)
Total	Unequal	5(1)	2(2)	1(1)	0(4)	8(8)

The numbers in the parenthesis give the choice when the degree of inequality is Nature. A destruction of the payoff by a poor (rich) individual has taken place if by a suffix 1p (1r). Likewise for the second period destruction is indicated by 2p or 2r.

cooperates in the first period, while with high inequality under the exogenous treatment the complete absence of cooperation can be observed in one economy only. Inequality thus does not in itself generate lower cooperative efforts. To the contrary, in the exogenous treatments no single economy was behaving non-cooperatively in both periods, be it the high or the low inequality treatment. This result again shows that inequality will be neutral to cooperation when inequality has come about by chance.

Moreover, in DicHi economies where one of the subjects is playing cooperatively in the first or in the second period, a destruction of the returns occurs in three out of five cases. Apparently, when the rich persons opt for high inequality, cooperation if it occurs easily leads to punishment by destruction if cooperation is not reacted upon by cooperation of others. Figure 2.1 gives yet again another representation of our results. The figure shows the observed growth rate of every economy in every treatment normalized to equilibrium growth. To derive the normalized growth rates, we subtract the equilibrium payoff of each individual from

the total payoff obtained in the experiment and express the result as a percentage of their endowment (see the fifth part of Table 2.2). The resulting number indicates to what degree the individuals have been able to realize a higher than equilibrium growth. Figure 2.1 shows the average normalized growth rates of all economies.

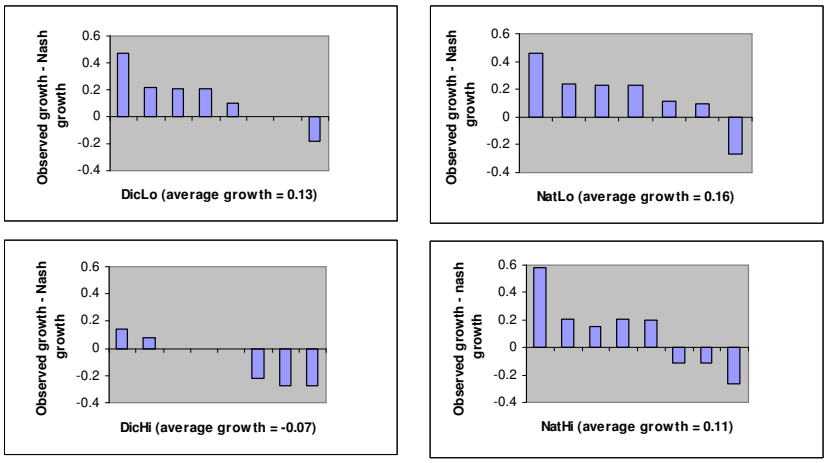


Figure 2.1 – Total growth for each economy and each treatment

In the dictator treatments, positive growth rates are obtained in 2 high inequality economies and 5 low inequality economies. In 3 high inequality economies sizable negative growth rates are observed, while this is the case in only 1 low inequality economy. As a result of these differences the average growth rate over all economies is clearly positive in the low inequality setting, while it is negative in the high inequality setting. In the nature treatments positive growth rates are obtained in 6 low inequality economies and 5 high inequality economies; in 3 high inequality economies negative growth rates are observed, while this is the case in 1 low inequality economy. Apparently, in the nature treatment the effect of inequality on growth is inconclusive, although average growth is somewhat higher in the low inequality setting.

Comparing the nature and dictator treatments, it appears that the differences in growth for given low inequality are only minor: in the nature treatment 6 out of 7 economies realize positive growth rates, while this holds for 5 out of 8 economies in the dictator treatment. As a result, the average growth rate is slightly higher in the nature treatment (0.16 versus 0.13). In the high inequality setting, however, the differences are clearly discernible: 5 out of 8 economies in the nature treatment

realize positive growth rates while in the dictator treatment 2 out of 8 economies realize positive but small growth rates, leading to a sizable difference in the average growth rate. This leads to:

Result 4 : Low inequality leads to higher growth than high inequality in the dictator treatment. No such effect can be observed in the nature treatment.

2.5 Conclusions

Both the empirical and the theoretical research on the relationship between inequality and growth have come to ambiguous results, sometimes finding a positive, sometimes a negative, and sometimes varying correlations. It seems that more theoretical and experimental work on the behavioral micro-foundations will be necessary to disentangle the complicated mechanisms that govern the relationship between inequality and growth. As discussed in chapter one, previous literatures do not find significant effect of inequality on the propensity to cooperate in an experimental setting the conjectured effect being that inequality destroys "social capital". The observed level of cooperation was independent of the implemented degree of inequality. Given the clear result, it seems evident that something more than inequality by itself is needed to observe the collapse of societal cooperation.

The hypothesis we started this paper with is that the degree of cooperation not only depends on the degree of inequality, but also on its genesis. To be able to examine this hypothesis, we first introduce a model that allows for out-of-equilibrium, but efficient, mutual cooperation in an unequal income setting. We then conduct laboratory experiments using this model in two variants. In the nature variant, the degree of inequality – either high or low inequality – is selected by the experimenter at random. In the dictator variant, the degree of inequality is selected by the only "rich" individual in the 3-person economy. The results of the experiment are as conjectured: Inequality is only detrimental to cooperation and, thus, to growth, when it is deliberately chosen by the rich dictator. Similar to earlier studies, inequality has no effect when it is brought on by a random draw, i.e. by a “fair

procedure".

Our result strongly supports the spreading view that the real output effects of inequality are linked to the institutions governing the economy (see Glaeser *et al.* 2003). The special contribution of our paper is to show a new channel through which this interaction may be effective. The channel we suggest and examine is that of voluntary cooperation in a social dilemma type of situation. The idea is that a substantial part of the effort that is put into production by the labor force is non-verifiable and, hence, will be dependent on the individual's trust and emotional attachment to the society. Clearly, these may both be severely damaged by inequality that results from the actions of a self-serving dictator, but not by inequality emerging from a fair competition. Moreover, the theoretical model can be enriched in several ways, e.g. by considering how perceptions affect the incentive to produce or by developing a dynamic setting in which the perceptions of individuals for a given distribution is made endogenous.

Appendix to Chapter 2

2A. Introduction

This is an experiment on economic decision-making within groups over 2 periods. These instructions explain the workings of the experiment and if you follow them carefully, you may earn a considerable amount of money, which will be paid to you in cash. You are expected to make decisions on your own without consulting other participants. So, please, do not communicate with the other participants. Otherwise, we might have to stop the experiment.

How does this experiment work? Each group consists of 3 participants, so you are in a group with 2 others in the room but you will not be able to identify your group members. The group members will be indicated by a color: Red, Blue, and Green. For the purposes of this instruction we will just talk of "your group members". At the beginning of period 1, each group member has some amount of start capital. At least one of your group members will have a start capital that differs from yours. The start capital that you get can be relatively low, or it can be relatively high. Which of the two will hold for you will be decided by the Red player, who in both cases will have the highest start capital in your group. Of course, if you happen to be the Red player you will decide on your own and the others' start capital.

Whatever your start capital may be you can enlarge your start capital over two periods by making a decision each period. These decisions determine the return that you are earning on your capital. The development of your capital does not only depend on your own decisions, but also on the decisions of the other members of your group. Based on these decisions, at the end of the 2nd period you will have accumulated a certain amount of final capital. From this final capital the start capital will be subtracted resulting in the payoffs that determine your earnings out of this experiment.

In each period, each group member chooses simultaneously one of two options: A or B. As will become clear from the payoff sheets to be discussed in a moment, if all group members choose B, the capital of all group members will grow more than if all choose A. However, if you choose B alone, while the other group members choose A, your capital will grow less while the others' capital will grow more, than if you had chosen A.

Consider the 2 payoff sheets on your desk. These sheets contain important information on

your payoff during the experiment. However, if we start playing the experiment, only 1 of the two payoff sheets are relevant for your decisions. Which payoff tables that will be, depends on the Red player's decision. If the Red player chooses the start capital of 220 for him- or herself and 40 for Blue and Green, payoff sheet 1 is relevant to all of you. But if the Red player chooses the start capital of 120 for him - or herself and 90 for Blue and Green, payoff sheets 2 is relevant to all of you.

Let us assume that a payoff sheet 1 is relevant. But, the same reasoning applies if payoff sheet 2 is relevant. For that case, just change in the following, payoff sheet 1 into payoff sheet 2. When you decide on A or B in the 1st period, you do not know your group members' 1st period choices. However, if you choose A in the 1st period, then, whatever the choices of your group members, payoff sheet 1 LEFT is from then on relevant for you. On the other hand, if you choose B in the 1st period, payoff sheet 1 RIGHT is relevant. So, a choice between A or B is a choice between payoff sheets 1 LEFT and 1 RIGHT. The structure of payoff sheets 1 LEFT and 1 RIGHT is identical. It suffices, therefore, to consider one of those payoff sheets only. Let us look at payoff sheet 1 LEFT, where your 1st period decision is A. Omit for a moment the table at the center of the page, saying, "If 1st period choice was Reset".

Payoff sheet 1 LEFT shows 4 payoff tables. These tables give the possible payoff you and your group members will generate, depending on you and your group members' 2nd period choices. The letters in the rows of those tables show the decisions of your group (including yourself) in period 2 and the numbers show the final payoff for you and your group members corresponding to these decisions. The first of those numbers is always your final payoff, while the next two numbers are those of your group members. Which of these four tables is relevant for you will depend on the 1st period choice of your group members. If they both choose A, then the first table saying "If 1st period choice was (A, A, A)" is relevant, but if the first other group member chooses A and the other one chooses B the second table saying "If 1st period choice was (A, A, B)" is relevant. The other two tables will be relevant, if the first other group member chooses B, and the other chooses A, or when they both choose B, respectively. In payoff sheet 1 RIGHT you will notice that the first letter in the headings of the payoff tables is not A, but B, corresponding with a 1st period decision of yours of B instead of A.

Once all 1st period decisions on A or B are made, the experimenter will collect all the decision sheets, and return them with the decisions of your group members on A or B included. Then you

will know exactly which payoff table on the left-hand side of the payoff sheet is relevant for you. Notice that in your payoff table the payoffs of your group members are shown as well. To help you the experimenter will mark this table with a cross.

After all group members know their payoff table, each group member is given a reset option. If one group member chooses to reset, then the capital of every group member after the 1st period will be reset to the start capital. What this implies for the payoff is shown by the "Reset" table at CENTER of Payoff sheet 1. You or one of your group members might prefer the Reset option over and above the relevant table at the left-hand side of the Payoff sheet.

The experimenter will communicate to all group members whether there has been a reset, or not. If not, then the table at the left-hand side that was marked with a cross will be the table that is decisive for your final payoff. But, if there has been a reset, table CENTER on the page is decisive.

After the decision whether or not to reset, the 2nd period starts. In the 2nd period again each group member chooses simultaneously from one of two options: A or B. Like in the 1st period, when you decide on A or B, you do not know your group members' 2nd period choices. If you choose A, then the first four rows in your relevant table shows you the possible payoffs for you and your group members. If you choose B, then the last four rows in your relevant table show you the possible payoffs for you and your group members. Which of those four rows is decisive for your final payoff depends on your group members.

After everyone has decided on A or B, the experimenter will collect the decision sheets and return them with the decision of your group members. Then you will know exactly which row in your payoff table is relevant for you. To help you the experimenter will mark this row with a cross. Again, after all group members have decided for A or B in the 2nd period, each group member is given a reset option. If one group member chooses to reset, then the capital of every group member after the 2nd period will be reset to the start capital of the 2nd period. What this implies for the final payoff is shown by the bottom row of the table saying, "Reset". You or one of your group members might prefer the Reset option over and above the relevant rows in your payoff table. Notice that if you are already in the Reset table, a reset choice in your group will lead to zero final payoffs for all group members. This is due to a choice for reset in the 1st and the 2nd period, which implies that the final capital for you and your group members equals the start capital. As a result the payoff for any of your group members, including yourself, equals the

show-up fee.

The experimenter will collect all decisions on the reset option and thereafter communicate to all group members whether there has been a reset, or not. If not, then the row in the table that was marked with a cross will be decisive for your final payoff. But, if there has been a reset, the bottom row of the table is decisive for your final payoff.

The final payoff will be exchanged into earnings at the rate of 20 cent per point. Your total earnings from the experiment are paid to you at the end of the experiment in cash. Additionally, each of you will receive a fixed payment of 3 Euro for participation in the experiment.

Summarizing. First the Red player decides on the distribution of capital. That choice determines whether the Payoff sheet 1 or Payoff sheet 2 is used. Your own 1st period choice determines whether sheet 1 LEFT or sheet 1 RIGHT (or, sheet 2 LEFT or sheet 2 RIGHT) is decisive for your and the others' payoff. The 1st period choices of your group members fix the table on the left/right-hand side of the relevant payoff sheet. However, if you or one of your group members chooses to reset in the 1st period, the "Reset" table on the center of the sheet is decisive. The 2nd period choices of you and your group members determine which row in the chosen table is going to be decisive for the payoffs. However, if any one in your group (including yourself) has opted for a reset in the 2nd period, the bottom row in the chosen table sets the payoffs for all group members.

Practice rounds. Before running the actual experiments, we give you the opportunity to have some practice. For these practice rounds you can use the payoff sheets on your desk, which are also used for the actual experiment. Moreover, you can use the practice sheets, which are handed out to you now. You will not be paid for the results of these rounds, these rounds are only meant to let you become acquainted with the structure of the experiment. First, we play two practice rounds together for payoff sheets 1. After that, we play two practice rounds together for payoff sheets 2.

During these rounds I announce what you and your group members are hypothetically doing. This information is indicated on your group-practice sheets by A1.1, etc. You indicate on your guided-practice sheets which payoff sheets, tables, or payoffs are relevant behind the questions Q1.1. etc.

2B. Payoff Tables

Payoff sheet of the rich in the high inequality treatment (Gini = 60.0). The other payoff sheets contained exactly the same information, but the columns of the tables were sorted in a way that had each subject's own payoff in the first column.

PAYOFF SHEET LEFT
START CAPITAL (220, 40, 40)
Payoff tables, if your 1st choice was A

If 1st period choice was (A, A, A)

Red	Green	Blue	Red	Green	Blue
A	A	A	44	26	26
A	A	B	84	35	19
A	B	A	84	19	35
A	B	B	123	28	28
B	A	A	36	35	35
B	A	B	76	43	28
B	B	A	76	28	43
B	B	B	116	36	36
	Reset		20	12	12

If 1st period choice was (A, A, B)

Red	Green	Blue	Red	Green	Blue
A	A	A	81	35	19
A	A	B	127	44	11
A	B	A	127	27	26
A	B	B	173	36	18
B	A	A	73	44	26
B	A	B	119	54	18
B	B	A	119	36	34
B	B	B	165	46	26
	Reset		56	18	5

If 1st period choice was (A, B, A)

Red	Green	Blue	Red	Green	Blue
A	A	A	81	19	35
A	A	B	127	26	27
A	B	A	127	11	44
A	B	B	173	18	36
B	A	A	73	26	44
B	A	B	119	34	36
B	B	A	119	18	54
B	B	B	165	26	46
	Reset		56	5	18

If 1st period choice was (A, B, B)

Red	Green	Blue	Red	Green	Blue
A	A	A	119	27	27
A	A	B	171	36	18
A	B	A	171	18	36
A	B	B	223	27	27
B	A	A	110	36	36
B	A	B	162	44	27
B	B	A	162	27	44
B	B	B	215	36	36
	Reset		93	12	12

PAYOFF SHEET CENTER
START CAPITAL (220, 40, 40)
If 1st period choice was Reset

If 1st period choice was Reset

Red	Green	Blue	Red	Green	Blue
A	A	A	20	12	12
A	A	B	56	18	5
A	B	A	56	5	18
A	B	B	93	12	12
B	A	A	13	18	18
B	A	B	50	25	12
B	B	A	50	12	25
B	B	B	87	19	19
	Reset		0	0	0

The tables on the left and right -hand side are decisive for your payoff if there has been no reset in the 1st period. If there has been a reset, the CENTER table determines your payoff. The last row of any table will be the payoff if there has been a reset in the 2nd period. Letters in the rows are 2nd-period choices of you and your group members Green and Blue; Numbers are the corresponding payoffs for you, Green and Blue.

PAYOFF SHEET RIGHT
START CAPITAL (220, 40, 40)
Payoff tables, if your 1st choice was B

If 1st period choice was (B, A, A)

Red	Green	Blue	Red	Green	Blue
A	A	A	39	34	34
A	A	B	78	44	27
A	B	A	78	27	44
A	B	B	117	37	37
B	A	A	32	44	44
B	A	B	71	54	37
B	B	A	71	37	54
B	B	B	110	47	47
	Reset		13	18	18

If 1st period choice was (B, A, B)

Red	Green	Blue	Red	Green	Blue
A	A	A	77	43	27
A	A	B	122	54	19
A	B	A	122	35	36
A	B	B	167	46	28
B	A	A	69	54	36
B	A	B	114	65	28
B	B	A	114	46	44
B	B	B	159	56	36
	Reset		50	25	12

If 1st period choice was (B, B, A)

Red	Green	Blue	Red	Green	Blue
A	A	A	77	27	43
A	A	B	122	36	35
A	B	A	122	19	54
A	B	B	167	28	46
B	A	A	69	36	54
B	A	B	114	44	46
B	B	A	114	28	65
B	B	B	159	36	56
	Reset		50	12	25

If 1st period choice was (B, B, B)

Red	Green	Blue	Red	Green	Blue
A	A	A	115	35	35
A	A	B	166	45	27
A	B	A	166	27	45
A	B	B	217	36	36
B	A	A	106	45	45
B	A	B	157	55	36
B	B	A	157	36	55
B	B	B	208	46	46
	Reset		87	19	19

Continued

Payoff sheet of the rich in the low inequality treatment (Gini = 10.0). The other payoff sheets contained exactly the same information, but the columns of the tables were sorted in a way that had each subject's own payoff in the first column.

PAYOFF SHEET LEFT
START CAPITAL (120, 90, 90)
Payoff tables, if your 1st choice was A

If 1st period choice was (A, A, A)

Red	Green	Blue	Red	Green	Blue
A	A	A	53	47	47
A	A	B	77	65	39
A	B	A	77	39	65
A	B	B	101	58	58
B	A	A	45	65	65
B	A	B	69	84	58
B	B	A	69	58	84
B	B	B	93	76	76
	Reset		24	21	21

If 1st period choice was (A, A, B)

Red	Green	Blue	Red	Green	Blue
A	A	A	76	65	40
A	A	B	103	86	32
A	B	A	103	56	58
A	B	B	131	77	50
B	A	A	68	86	58
B	A	B	95	107	50
B	B	A	95	77	75
B	B	B	122	98	67
	Reset		44	36	15

If 1st period choice was (A, B, A)

Red	Green	Blue	Red	Green	Blue
A	A	A	76	40	65
A	A	B	103	58	56
A	B	A	103	32	86
A	B	B	131	50	77
B	A	A	68	58	86
B	A	B	95	75	77
B	B	A	95	50	107
B	B	B	122	67	98
	Reset		44	15	36

If 1st period choice was (A, B, B)

Red	Green	Blue	Red	Green	Blue
A	A	A	99	58	58
A	A	B	129	78	50
A	B	A	129	50	78
A	B	B	160	70	70
B	A	A	90	78	78
B	A	B	121	98	70
B	B	A	121	70	98
B	B	B	151	89	89
	Reset		64	30	30

PAYOFF SHEET CENTER
START CAPITAL (120, 90, 90)
If 1st period choice was Reset

If 1st period choice was Reset

Red	Green	Blue	Red	Green	Blue
A	A	A	24	21	21
A	A	B	44	36	15
A	B	A	44	15	36
A	B	B	64	30	30
B	A	A	18	36	36
B	A	B	38	51	30
B	B	A	38	30	51
B	B	B	58	45	45
	Reset		0	0	0

The tables on the left and right -hand side are decisive for your payoff if there has been no reset in the 1st period. If there has been a reset, the CENTER table determines your payoff. The last row of any table will be the payoff if there has been a reset in the 2nd period. Letters in the rows are 2nd-period choices of you and your group members Green and Blue; Numbers are the corresponding payoffs for you, Green and Blue.

PAYOFF SHEET RIGHT
START CAPITAL (120, 90, 90)
Payoff tables, if your 1st choice was B

If 1st period choice was (B, A, A)

Red	Green	Blue	Red	Green	Blue
A	A	A	47	64	64
A	A	B	70	85	56
A	B	A	70	56	85
A	B	B	93	77	77
B	A	A	39	85	85
B	A	B	62	106	77
B	B	A	62	77	106
B	B	B	85	98	98
	Reset		18	36	36

If 1st period choice was (B, A, B)

Red	Green	Blue	Red	Green	Blue
A	A	A	71	82	58
A	A	B	97	106	50
A	B	A	97	73	78
A	B	B	123	97	69
B	A	A	62	106	78
B	A	B	88	129	69
B	B	A	88	97	98
B	B	B	114	120	89
	Reset		38	51	30

If 1st period choice was (B, B, A)

Red	Green	Blue	Red	Green	Blue
A	A	A	71	58	82
A	A	B	97	78	73
A	B	A	97	50	106
A	B	B	123	69	97
B	A	A	62	78	106
B	A	B	88	98	97
B	B	A	88	69	129
B	B	B	114	89	120
	Reset		38	30	51

If 1st period choice was (B, B, B)

Red	Green	Blue	Red	Green	Blue
A	A	A	93	76	76
A	A	B	123	99	67
A	B	A	123	67	99
A	B	B	153	89	89
B	A	A	84	99	99
B	A	B	114	121	89
B	B	A	114	89	121
B	B	B	143	112	112
	Reset		58	45	45

Chapter 3

Which Kind of Heterogeneity Degrades Trust?

3.1 Introduction

A recent hypothesis in the behavioral economics literature is that economic performance will be furthered by the absence of social and ethnic divisions (see e.g. Easterly and Levine, 1997 and Alesina *et al.* 1999). Knack and Keefer (1997), for example, note that for countries like Norway, Finland, Sweden, Denmark and Canada, a high degree of homogeneity both in terms of race and income goes with a high degree of economic performance.[1] Or, the other way around, individuals in heterogeneous societies are less likely to cooperate with others in social networks. Alesina and La Ferrera (2000), e.g., demonstrate with US survey data that people living in more unequal and racially fragmented areas cooperate less.

The explanation behind this linkage is that people with similar characteristics are more likely to form a group and thus cooperate. However, it is not clear beforehand which dimension is predominantly driving the positive homogeneity-growth relationship. Is homogeneity of race or homogeneity of income the most

[1] Incidentally, based on the World Social Survey measurement, these five countries also have the highest level of trust. The close correlation between trust, social homogeneity and economic performance can also be derived from the experimental results by Glaeser *et al.* (2000) who find that when individuals are closer socially; trust and trustworthiness tend to be higher.

relevant dimension? If people differ on the race dimension, but not on the income dimension, will growth be higher or lower than if people differ only on the income dimension, all other things remaining equal?

Alesina and La Ferrera (2000) suggest that aversion to racial mixing is a prime variable explaining the low degree of social participation in heterogeneous societies. Several experimental studies have established that racial or ethnic heterogeneity among individuals decreases the willingness to cooperate (see, e.g., Gneezy and Fershtman, 2001, Eckel and Wilson, 2003, and Burns, 2003). These studies, however, do not try to assess whether the observed ethnicity effect is confounded with income effects. The discrimination that is found to exist towards other ethnic or racial groups may be due to the (low) incomes of subjects from discriminated groups, instead of being driven by purely racial or ethnic motives.

We ran experiments in which the effect of, in particular, race and income are separated. To disentangle the separate effects of income and ethnic or racial differences, our experiments had to be conducted in a country where differences along both these dimensions are bold. South Africa is such a country, as it is characterized by large heterogeneity along both racial and income lines. In particular, before the break down of apartheid in 1994 the black population[2] received less than 50% of the national income, but this share had risen to 75% in 1995 (Stewart, 2002).[3] However, at the same time intra-racial income inequality had increased. Amongst black households the Gini index increased from 0.49 in 1970 to 0.59 in 2000, while among the whites it moved from 0.43 to 0.49 (Whiteford and van Seventer, 2000).

We employed the trust game, originally developed by Berg, Dickhaut, and McCabe (1995). The game is called a trust game as the amount the sender transfers to the receiver gives an indication of the sender's trust in the willingness of the receiver to reciprocate, and thus mirrors the interaction between people in "real life", where trust is a precondition for the emergence of sustained interaction.

[2] According to the 1996 census 77% of the 40,583,573 people in the country were black and 11% were white, while Indians (3%) and colored (9%) people made up smaller percentages.

[3] South Africa had a Gini Index of 58 in 1997, which made it the country with the highest inequality after Brazil with a Gini index of 63 (World Bank, 1997).

This game is, therefore, perfectly suited for analyzing the core issue that we address in this chapter, viz. to what degree racial divisions and income differences within and between groups are hampering economic development, due to a lack of trust. More in particular, the questions that we raise include: Is the cooperative attitude of South African people in general, disregarding their own and their opponents' race or income, much different from people in countries with different or like characteristics? Is the counterparts' race the basic determinant for individuals' propensity to cooperate, or can income have a neutralizing, or, the other way round, a reinforcing effect? The answers to these questions are obviously vital to economic and social development, which require trust among groups in order to facilitate exchange in interaction.

As noted above, previous studies are limited to examining the ethnicity effect on individuals' willingness to trust and to reciprocate cooperative behavior. Gneezy and Fershtman (2001) provided individuals information on the last name of their counterpart, from which the individuals were supposed to infer the ethnicity of their partner. They find a systematic mistrust resulting from ethnic differences between subjects and interpret this as economic discrimination. In a study with US subjects, Eckel and Wilson (2003) find that allowing subjects to observe a picture of their counterpart increases trust and trustworthiness more than when subjects have no physical information on their partner. In addition to this, they find that minority groups (in particular African-Americans) are less likely to be trusted than the majority groups (Caucasian). Burns (2003) conducted dictator and trust games with high school students in the greater Cape Town area .[4] Subjects were shown

[4]Experimental studies on trust in (South) Africa using experiments are rare. Barr (2003) conducted experiments in Zimbabwe in order to detect which factors contribute to the feeling of shared social identities within communities. Carter and Casteillo (2003) examine the level of trust for South African communities in the province of Kwa Zulu–Natal, and investigate whether rural or urban communities make a difference for the degree of trust between ethnically homogeneous subjects. Closely related is the household-level study of Haddad and Maluccio (2003) in KwaZulu-Natal. Their result suggests that local trust (in neighbors and extended family) and income level are important for financial group participation, which is believed to affect positively the enhancement of social capital.

photographs of their counterpart so as to check the effect of race on the propensity to trust. She finds that in dictator games blacks are favoured by non-whites, while whites as first movers do not show any bias against the race characteristic of their counterpart. In trust games, however, black students are sent on average less by all student groups, including black students themselves, which suggests that discrimination against the blacks is taking place.

Our experiment is the first to try to disentangle the two main division lines that may exist in heterogeneous societies, i.e. the racial or ethnic and the income divides. In the trust games that we employ the subjects are given information on the income and the race of the partner with whom they are playing the game. By varying the amount of information and by recruiting subjects from several race and income groups, we control for the effects of race and income. Surprisingly, similar to many experiments, no significant behavioral differences are found when no information is provided to subjects about their partners' characteristics. This seems to indicate that subjects in South Africa behave in general, i.e. outside their specific social context, not different from individuals elsewhere in the world. Only when context is added, behavior becomes specific. Taking account of both income and racial differences we find that income inequality adds envy to racial difference. In particular, individuals from less privileged, i.e. low-income groups tend to refrain from cooperation with advantaged individuals from other racial groups.

We proceed in the following fashion. Section 3.2 describes the experimental protocol. Section 3.3 contains the results on the effects of information. In particular it discusses whether discrimination, if it exists, is based on income or on race. Section 3.4 figures out the correlates of survey questions with experimental decisions and thereby analyzes the impact of social distance on the propensity to trust. The last section concludes.

3.2 Experimental Procedures

The subjects played the one-shot trust game. We applied the strategy method where each subject, given the information on his or her counterpart, had to decide

how much to transfer both in the role of sender and the role of receiver.[5] Subjects knew at the start of the experiment that they had to play both roles. The role that determined their payoff was decided upon a random draw. Both sender and receiver were supposed to be endowed with 20 Rand. (At the time of the experiment the exchange rate was €1 = 7.8 Rand). As a sender a subject was asked to decide how much of the 20 South African Rand he/she would want to transfer to the receiver. After this subjects were asked to state their expectation on the return transfer by the receiver.[6] As a receiver he/she was asked to choose how much he/she would be willing to give back to the sender for each of the 11 possible amounts that the senders could send to him/her. That is, subjects were reporting strategies in response to possible moves by other players. Subjects were also asked to predict what the sender intended to do (see the instructions in the Appendix for more details on the procedure applied).

The treatment variable was the information subjects received on the characteristics of their counterparts. Upon recruitment subjects were asked to state their race[7] and to evaluate their family income compared to average South African income. Based upon this information we categorized our subjects according to race (B=black; W=white) and income (L=low income; H=high income). In one treatment complete information (i.e. on race, and income position of the counterpart) was given to the subjects. In a second treatment no information was given regarding their counterpart. The experimental conditions, including the number of observations for all the distinguished subject types and treatments are summarized,

[5] We applied the strategy method, as we had to recruit a large part of our subjects on the spot and did not know in advance whether a counterpart for each recruited subject could be found.

[6] Subjects were not paid for formulating their expectations, but only on the actions of the amount sent and returned.

[7] In South Africa students are normally asked to indicate their race upon registering for a university or a school. So, asking for this information does not have to generate suspicion with the subjects regarding the experimenters' intentions. No single subject objected to providing the information on the race. We asked for this information before conducting the experiment in order to get a balanced distribution of subjects. We concentrate our studies on African Blacks and Whites.

Table 3.1: Experimental Conditions and Number of Observations in South Africa Trust Game.

Subjects	No	Information[1)]				
Characteristics	Information[1)]	BL	BH	WL	WH	Total
BL	15	15	15	15	20	80
BH	1	6	1	0	6	14
WL	4	4	7	7	10	32
WH	8	9	8	10	11	46
TOTAL	28	34	30	32	47	172

[1)]In the "No information" treatment subjects were not given information on race and income of their partner, and in the information treatment they knew the race and income and income of their partner, before they made experimental decisions.

in Table 3.1. Unfortunately, we were only able to recruit a relatively low number of BH subjects, so that we could not fill all the cells with enough observations.

The experiments were conducted in October 2003, at the Potchefstroom University[8] (predominantly white) and the Mafeking University (predominantly black). The experiment was done with pen and paper. After all sessions were completed, the decision form of subjects was linked to another subject of the type prescribed in their decision form. Eventually, the role of the subject was determined and the payoff was calculated using the decision of the subject and their counterpart filled out in their decision form. After this the students collected their earnings.

3.3 Experimental Results

3.3.1 Outcomes without race and income information

The original trust game in Berg et al. (1995) was not conducted within a specific social context, as individuals were not provided with information on their partners' characteristics. To check whether our results conform theirs, a number of subjects were determining their strategies without knowing anything about their potential

[8]Conducting the experiments was made possible by the hospitality of the Economics Department of Potchefstroom University; especially professor Wim Naudé's support was indispensable.

Table 3.2: Comparison of Behavior of Subjects in Berg *et al.* (1995) and South Africa

	Berg *et al.*	South Africa[1)]	
	(1995)	No Information	With Information
Initial endowment Size	10.00 US $	20.00 ZAF $	20.00 ZAF $
Independent Observations	32	28	144
Proportion of players who sent zero	0.06	0.04	0.09
Mean amount sent out of endowment	0.52	0.55	0.45
Mean return ratio	0.28	0.28	0.29

[1)]In Berg *et al.* (1995), second players make responses only when senders invest more than zero while in South African experiment subjects continue to play as we used the strategy method.

partners. In Table 3.2 the columns "Berg *et al.* (1995)" and "No information" compare the Berg *et al.* (1995) results with our no information results. Table 3.2. presents the proportion of senders who sent zero, and the average amount sent and returned as a proportion of available amount (i.e. initial endowment and received transfer), respectively.

It turns out that no behavioral differences between the Berg *et al.* (1995) subjects and our no information subjects can be observed. There are some slight differences in the numbers, but none of these are statistically significant.[9] This conclusion, however, need not hold for all the distinguished treatment groups. Therefore, in Table 3.3 we look at the average amounts sent and returned as a percentage of the endowment for three of the four distinguished groups.[10]

We also added the average amount the senders anticipate to get back from the receivers, and the average amount expected to be received from the senders by the receivers. On the whole, the numbers in the respective rows look rather similar, and, indeed, statistical tests reveal no significant differences across groups.

Thus, despite the fact that the South African society is rather heterogeneous,

[9]The Mann-Whitney test on the equality of medians of the amount sent between South African experiment and Berg *et al.* 1995 is equal to p= 0.83. The proportion returned in our experiment was similar to Berg *et al.* 1995 and not surprisingly no significant difference appears. The Mann-Whitney test statistic equals 0.34.

[10]BH individual is excluded from this analysis because of the low numbers of observations under the no information treatment.

Table 3.3: Averages as a percentage of available amounts under No Information treatment

	BL	WL	WH
Amount sent (%)	56.00	60.00	56.25
Anticipated return (%)	30.93	33.25	33.25
Amount returned (%)	29.65	25.75	29.59
Anticipated amount sent (%)	62.00	70.00	61.25

the general level of trust and trustworthiness as measured by the trust game is similar to more homogenous societies, as our no information treatment elicits the same kind of behavior as the analogous treatment in the original Berg *et al.* (1995) experiments. As these results have proven to be typical for many analogous settings in many parts of the world (see Camerer, 2003, for a survey), these first results indicate that in the absence of any known racial or income differences between partners the intrinsic behavior of the South African students, irrespective of their race and income, fully corresponds to the observed behavior elsewhere in the world.

3.3.2 Outcomes with race and income information

The last column of Table 3.2 displays the average effect of the information treatment, where subjects have information on the characteristics of their counterparts. We observe that on average, a lower proportion of the endowment is sent. This difference is statistically significant at the 10% level (non- parametric Mann-Whitney U-test based on rank in the amount sent with and without information gives p= 0.07). The presence or absence of information on race and income, however, does not result in a behavioral difference in the amount returned as a proportion of available amount. In both treatments the amount returned by subjects monotonically increases with an increment in the amount sent. However, similar to many findings in the literature, the amount returned increases at a decreasing rate as the potential amount to return increases. Figure B3, in Appendix B, depicts the box plot of the amount returned for all potential available amounts.

Thus on average, information on race or income leads to lower trust from

senders, even though the trustworthiness, as measured by the average return as a proportion of available amount, is not affected by the provided information. However, as we have specific information on the effect of race and income for our four distinguished groups, we can analyze whether differences exist between groups .[11]

Figure 3.1 shows the percentage of the initial endowment that is sent by subjects from the different groups (BL, BH, WL and WH, respectively) to subjects from their own or other groups. The average percentage sent in the No Information treatment (i.e. 55%) serves as a benchmark (indicated by the line). We have the following results.

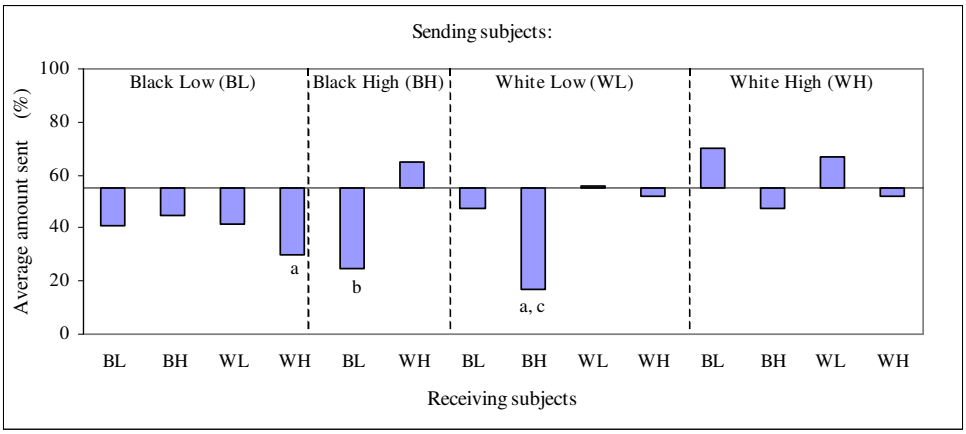


Figure 3.1: The bars represent the average amount sent by the subjects mentioned at the top to the subject groups indicated on the X-axis. $^{a)}$ Statistically significant different from the no information benchmark. $^{b)}$ Statistically significant lower than the amount sent by BH to WH. $^{c)}$ Statistically significant lower than the amount sent by WL to WH, WL and BL.

When BL subjects are given information on their counterpart, they send less than in the absence of such information. This holds for all groups they send to, but they only send to WH-subjects (statistically) significantly less than in the no infor-

[11] Detailed information on the average amount sent, returned and the anticipations about return gifts and sent amount as a percentage of available amount is presented for all groups in Appendix B.

mation benchmark case.[12] Just as BL-subjects, WL-subjects send less as senders when they get information on their counterpart, except that they send slightly more to subjects from their own group than to subjects with unknown characteristics in the benchmark case (i.e. 55.71% versus 55%). They send especially (and statistically significant) less to BH-subjects than to subjects from all other groups: BH subjects receive only 17.15% from WL-subjects, while subjects from other groups receive at least 47%.

Thus, the less privileged subjects in terms of income give low amounts to, especially, subjects with a different race and a different (thus in this case high) income. The lower amounts sent by BL and WL-subjects do not have to be based on mistrust against, respectively, WH and BH-subjects. In fact, considering the amounts BL and WL-subjects expect to receive back from their partners, see Figure 3.2, the BL-subjects, especially, do not expect different amounts back from subjects of whatever race or income. So, the substantially lower amounts they send to WH subjects can only be explained by a mere absence of willingness to cooperate with this type. In other words, BL subjects show some inclination to discriminate against WH subjects. For WL-subjects the picture is different: they expect to get back significantly less from BH-subjects than from white subjects. Especially, they put a lot of confidence in WH-subjects compared to both low-income and high-income black subjects. So, the lower amounts sent to BH subjects by WL subjects can be explained more out of a lack of trust than out of discrimination.

BH-subjects send a significantly higher proportion of their endowment to white subjects with a high income than to BL-subjects.[13] Figure 3.2 shows that the lower amounts sent to BL-subjects are not based on mistrust against these subjects. They expect roughly the same return from WH as for BL-subjects.

[12] We compare the groups decisions with the overall averages (bench mark case) as it does not change our results when one makes comparison with group averages. Moreover, for the BL types, we also did not find any statistically significant behavioral difference among BL subjects due to location effect. (Potchefstroom vs. Mafikeng).

[13] Unfortunately, the number of BH-subjects in these experiments was too low to allow for meaningful statements regarding transfers of BH-subjects to WL and BH-subjects, respectively.

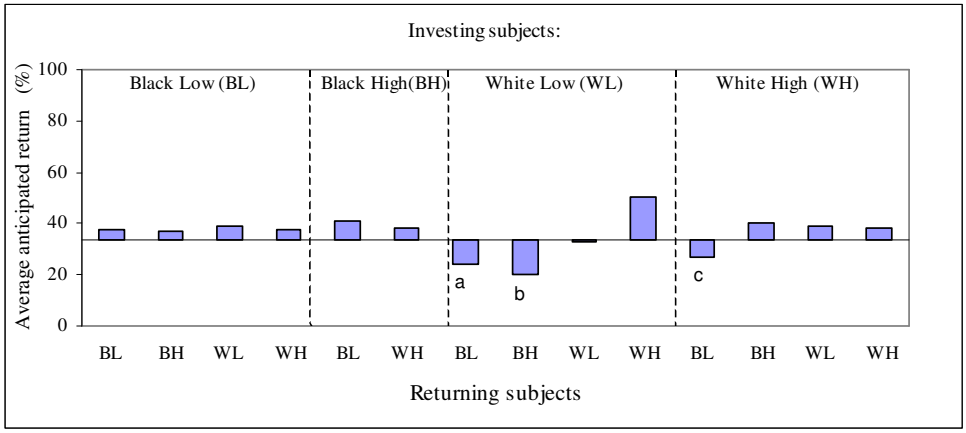


Figure 3.2: The bars represent the average return the subjects mentioned in the top expect to get back from the subject groups indicated on the X-axis. $^{a)}$ Statistically significant anticipation of a higher return is observed by WL from WH than BL. $^{b)}$ Statistically significant anticipation of a lower return is observed by WL to BH than to WL and WH. $^{c)}$ Statistically significant anticipation of a lower return is observed by WH to BL than BH.

The group of WH-subjects is the only group that does not appear to be affected by the information they get on their partner in the trust game. Although they send slightly more to low-income types than to high-income types, these differences are not statistically significant. However, they do expect a higher returns from BH than BL subjects. (Mann-Whtney, p=0.011)

Figure 3.3 indicates the return the subject groups receive on their transfers as senders from the distinguished subjects groups. Most of the differences between the returns are too small to produce statistically significant differences. On comparing Figure 3.3 with Figure 3.2, a few striking effects stand out.

First, the relationship between WH and BL subjects is rather peculiar. BL subjects as senders expect to get a return from WH subjects higher than the benchmark return gift, and indeed, from Figure 3.3 we notice that WH subjects give a relatively high return gift to BL subjects. Nevertheless, BL subjects send low amounts to WH subjects (Figure 3.1), implying that by discriminating WH subjects they are hurting themselves. On the other hand, WH subjects expect to get a low return from BL subjects and indeed, they get a relatively low return. In

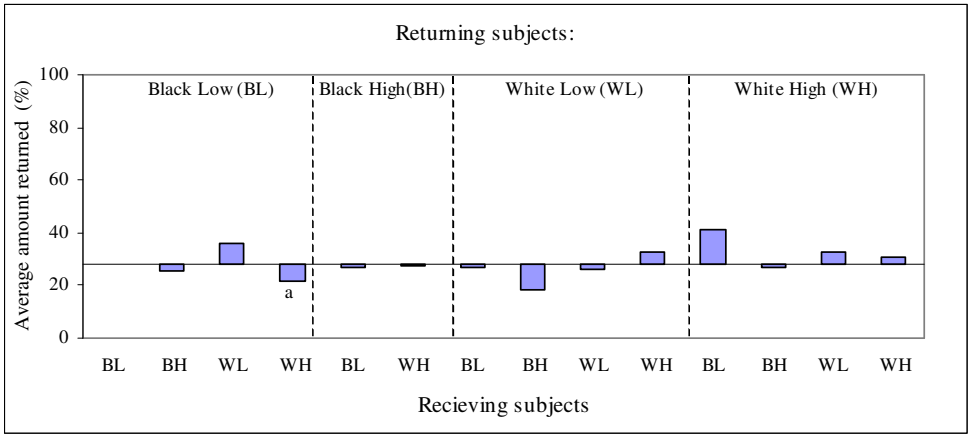


Figure 3.3: The bars represent the average return by the subjects mentioned in the top towards the subject groups indicated on the X-axis. $^{a)}$ Statistically significantly lower than the amount returned by BL to WL.

spite of that WH subjects are on average rather generous to BL subjects. Thus, just as with the BL subjects, WH subjects are hurting themselves by being altruistic towards the BL subjects.

Second, the only significant difference in Figure 3.3 is that BL subjects return less to WH subjects than to WL subjects. BL subjects even return less to BH subjects than to WL subjects although this difference is not statistically significant. Apparently, it seems that the discriminating behavior of BL subjects towards WH subjects is not based on racial considerations. In the next subsection we will go into the question as to whether racial discrimination can be detected.

In Figure 3.4, the percentage of the endowments that the returning subjects anticipate to receive from the senders is represented, compared to the no information benchmark case. Most of the direction of the effects conforms to the above results, i.e. BH subjects anticipate to be sent more from WH subjects than from BL subjects, and WL subjects expect especially less from BH subjects than from subjects of their own group. As indicated in the figure, these last differences are statistically significant.

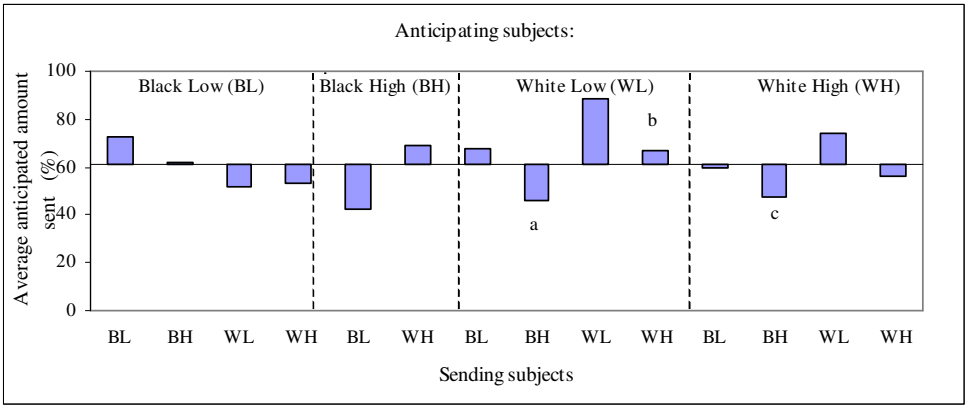


Figure 3.4: The bars represent the average percentage of the senders' endowment the subjects mentioned in the top box as receivers anticipate to receive from the subject groups indicated on the X-axis as senders. $^{a)}$ Statistically significantly lower than the amount anticipated by WL to be sent to them by WL and WH. $^{(b)}$ A statistically significantly lower amount is anticipated by WL to be sent to them from WH than from their own group. $^{(c)}$ WH anticipates a statistically significantly lower amount to be sent to them from BH than WL.

3.3.3 Discrimination based on race or income?

The above results demonstrate the complicated race-income relationship that apparently holds in the South African society. Trust, mistrust, discrimination, and cooperative attitudes cross racial and income lines in non-trivial ways. This seems to suggest that discrimination, if it exists, is not based purely on race or income, but rather on an adverse interaction between racial and income inequality. This claim is evaluated by analyzing whether pure racial or income effects of our treatment variables can be found in our data.

In order to assess the pure racial effects, we examine trust and trustworthiness within different race but the same income groups. To be more specific, we take as a benchmark homogeneous partners in the full information trust games, who are equal both in terms of income and in terms of race, i.e. the couples BLBL, WLWL, and WHWH, respectively. We compare each benchmark couple with a couple where the second subject differs from the first subject by his or her race, but not by income. If a change in race alone produces a significant effect on the

first player's behavior, then apparently racial discrimination is causing this effect.

Taking a look in Table 3.4.[14], keeping income fixed we find that subjects do not behave differently towards subjects from a different race: none of the produced differences are significantly different from zero. Keeping race fixed, one significant difference can be observed: the average expected amount WL subjects expect to receive from subjects out of their own group is higher than what they expect to get from WH subjects, i.e. 88.51% versus 67%.

Looking at the third part of Table 3.4 that takes into account the interaction effects of race and income, we observe several differences. In accordance with the results above, we do find BL subjects to reciprocate more towards WL than WH, namely 35.92% and 21.63%, respectively, though not statistically significant.

Regarding the behavior of WL subjects, their mistrust against BH subjects is very clear from the table. They send more to all other groups. The ensuing differences are all statistically significant. Moreover, WL subjects expect to get less in return from BH subjects than from subjects of the two white groups. Regarding their attitude on BL subjects, on the other hand, such an unambiguous expectation of low returns on sent amount cannot be observed. Apparently, WL subjects have a biased opinion on BH subjects' behavior, but this bias is somewhat less pronounced regarding BL subjects.

An intriguing significant relationship is given by the attitude of BH subjects towards BL subjects. BH subjects send a significantly higher percentage of their initial endowment to WH subjects than to BL subjects, i.e. 65% compared to 25%.[15] BH subjects, moreover, expect the BL subjects to send them less than WH subjects send them. In actual fact, BL subjects did not send less to BH subjects than to subjects from other groups. One might interpret this result as implying that rising intra-group inequality has reduced trust within the races instead of between the races, as seen by the BH subjects tending to invest more in WH subjects than

[14] Table 3.4. is a reorganization of the information in Figures 3.1-3.4.

[15] Due to the fact that we didn't have enough black high subjects, we only compared observed behavior between two treatments as shown in Appendix B.

Table 3.4: Differences in the average amounts of subject's decisions with respective treatments

Pair	Amount sent	Anticipated return	Amount returned	Anticipated amt sent
		Pure Racial Effect		
BLBL-BLWL	-0.65 (0.811)	-0.33 (0.890)	-7.96 (0.320)	20.85 (0.117)
WLWL-WLBL	8.21 (0.764)	9.00 (0.210)	-0.68 (0.930)	21.01 (0.221)
WHWH-WHBH	4.30 (0.996)	4.30 (0.919)	3.69 (0.599)	8.85 (0.249)
		Pure Income Effect		
BLBL-BLBH	-4.00 (0.826)	0.50 (0.670)	2.75 (0.740)	10.85 (0.303)
WLWL-WLWH	3.71 (0.994)	-17.10 (0.181)	-6.58 (0.813)	21.51 (0.099)
WHWH-WHWL	-15.20 (0.298)	-0.57 (0.986)	1.96 (0.704)	17.65 (0.255)
		Interaction of Racial and Income Effect		
BLWL-BLBH	-3.35 (0.962)	1.73 (0.510)	10.71 (0.110)	-10.00 (0.538)
BLWH-BLBH	-14.65 (0.218)	0.83 (0.550)	-3.58 (0.470)	-8.75 (0.563)
BLWH-BLBL	-10.65 (0.318)	0.33 (0.550)	-6.33 (0.470)	19.60 (0.122)
BLWH-BLWL	-11.30 (0.112)	-0.90 (0.710)	-14.29 (0.350)	1.25 (0.820)
BHWH-BHBL	40.00 (0.011)***	-2.17 (0.853)	0.85 (0.420)	26.65 (0.106)
WLBH-WLBL	-30.35 (0.012)***	-3.71 (0.494)	-8.24 (0.320)	-21.79 (0.300)
WLWH-WLBL	4.50 (0.84)	26.10 (0.051)**	5.90 (1.000)	-0.50 (1.000)
WLWL-WLBH	38.56 (0.001)***	12.71 (0.050)**	7.56 (0.380)	42.80 (0.027)**
WLWH-WLBH	34.85 (0.027)**	29.81 (0.005)***	14.14 (0.330)	21.29 (0.13)
WHWH-WHBL	-18.20 (0.200)	11.20 (0.181)	-10.27 (0.551)	-3.65 (0.832)
WHWL-WHBH	19.50 (0.262)	-1.20 (0.966)	5.70 (0.880)	26.50 (0.009)***
WHWL-WHBL	-3.00 (0.844)	11.69 (0.387)	-8.31 (0.365)	14.00 (0.447)
WHBH-WHBL	-22.50 (0.137)	12.89 (0.011)**	-13.96 (0.223)	-12.50 (0.355)

The entries give the difference in the average values (in terms of %) the amount sent, returned and expectations under complete information. The numbers in the brackets denote p-values of the Mann-Whitney U-test. *, ** and *** denote significant at 10%, 5% and 1% respectively.

in BL subjects.[16]

Finally, for WH subjects, we do not find any statistically significant differences in their behavior towards subjects from other groups, but only in their expectations about reciprocity and trust. They expect to get more in return from BH than from BL subjects, and expect that WL subjects as senders will send them more than BH subjects. The latter expectation is not based on racial stereotypes, however, as WH subjects do not expect to be sent less by BL subjects than WL subjects.

The observed action of subjects has resulted in payoff differences between different treatments. A comparison of average earnings for all groups between complete and incomplete information, which actually is the reflection of the behavior responses of subjects discussed in the previous sections, is presented in Table B3 and B4. (See Appendix B).

The major results of the difference in expected payoffs with respective treatments can be summarized in the following way. Firstly, the payoff interaction of the racial pair of BL and WH yields a statistically significant payoff difference due to the fact that WH are generous towards BL subjects. BL on the contrary, tend to invest and return lower amount of South African Rand. As a result the BL subjects benefited a lot by being matched with WH subjects. On the contrary the expected payoff of WH subjects as sender and receivers is drastically lower when matched with BL subjects.

The result in earning differentials is not because individuals from high income groups are generous towards low income subjects. For example, when WL subjects are matched with WH, no substantial payoff difference is observed. To the contrary WL (as a sender) will be better off if matched with their own type. Thus WL subject, as a sender is better off if matched with in their own group than, for example, with WH.

Secondly, the payoff interaction of the racial pair of BL and WL yields a statistically less significant income payoff for the BL subjects. This is because the

[16] La Farrara (2002) also finds that when inequality is higher, group composition is less likely to be formed on a mixed income group indicating that people tend to sort into homogeneous income groups.

BL subjects were generous towards the WL subjects. The expected payoff of BL subjects when matched with WL is less than when a BL is paired with his/her own type. Consequently WL subject, will gain more if matched with BL subjects. For a WL subject, as a sender he will earn 6.94 dollar more if matched with BL type than with his own type. Again this is a clear indication that there is no negative pure racial effect .

More so the payoff interaction of the racial pair of BL and BH results to a statistically significant expected payoff differences. When BH are paired with WH, the expected payoff BH as senders is significantly higher when matched with their own income group i.e. with WH than with BL. This means that since on average responders are conditionally cooperative i.e. give back out of available amount in non monotonic way, then BH subjects received a less amount on average from BL. In addition to this BH groups tend to reciprocate very little towards BL subjects. As a consequence, a BL individual is always better off to be matched with BL type than with BH type.

3.4 Determinants of Experimental Decisions

A secondary contribution of this paper is to explore the extent to which individual subjects' answers to a variety of survey questions can explain the observed behavior. In all regressions, we include the control variables i.e. gender (female and male), race (white and black) and income (low and high), match characteristics, parents education, attitudinal questions i.e. WVS questions, perception and economic position questions and, finally, we also include participants beliefs in the experiment i.e. about the amount they want to return, and what they expect from the senders.[17] The dependent variable for the sender is the percentage of the amount sent out of the initial stake passed to the responder. For the responder, the dependent variable is the percentage of the amount that was passed back to the sender out of the total available amount. Details on variable definitions are

[17]Principal component analysis has been used to construct both trust and perception index. This method was also applied by GLSS (2000).

included in Appendix C.

First, we discuss the correlate of amount sent to other variables which are often mentioned as a determinant of trust, and then we examine the determinants of amount returned.

3.4.1 Amount sent

The non-parametric results in section 3.3 suggest that social distance in terms of both racial and income differences do have a significant influence on the observed behaviour of the amount sent. This section tries to replicate this findings with econometric analyses of the participant's decisions. We use the two -limit Tobit estimator, as the dependent variable is the proportion of the amount sent; thus, the dependent variable is a continuous variable but must lie between 0 and 1. Moreover, our data suggest that 9.02% and 18.75% of subjects, who participated on complete information treatment, sent zero and entire amounts respectively. This justifies the use of the double censored Tobit estimator that can be represented as follows:

$$s_i^* = x_i'\beta + \varepsilon_i \tag{3.1}$$

where s_i^* is a latent variable (unobserved for values smaller than 0 and greater than 1) representing the proportion of amount sent out of initial stake; x is a vector of independent variables, which also includes the participants beliefs affecting experimental trust; β is a vector of unknown parameters; and ε_i is an error term assumed to be independently and normally distributed with zero mean and constant variance and $i = 1, 2, ...N$ (N is the number of observations). Denoting s_i^* (the proportion of amount sent) as the observed dependent (censored) variable:

$$s_i = \begin{cases} 0 \;\; if \;\; s_i^* \leq 0 \\ s_i^{*p} \; if \; 0 \leq s_i^* \leq 1 \\ 1 \; if \;\; s_i^* \leq 1 \end{cases} \tag{3.2}$$

Using the two-limit Tobit, the propensity to trust is regressed on proxies for various factors hypothesized to influence the amount sent. The estimated results are presented in Table D1.

The regressions include the pairing characteristics of subjects, such as income or race similarity. In our regressions, we include a dummy variable that takes on a value of one, if the sender was matched with different race, and zero otherwise. The estimate of racial distance, captured by a variable RACE_HETRO, is not significant at any conventional levels. Unlike Gneezy and Freshman (2000) and Glaeser and *et al.* (2000), the amount sent in the South African experiment is not affected by the familiarity of the race of the subject with other participants. We also include a dummy variable that takes on a value of one if the subjects are matched with different income groups. We find that when individuals are matched with different income groups, amount transferred is higher. The coefficient of INCOME_HETRO is marginally significant at 10% in the last specifications as shown in regression [5]. The measure of social distance in both income and race has the expected negative sign but is not statistically significant, failing to replicate the non-parametric results. This is partly attributed to the fact that in our sample the WH subjects sent a higher amount towards BL subjects and this understates the negative effect of SOCIAL DISTANCE variable on the propensity to trust. Results from non-parametric results suggest that the negative effect of race comes from the low inequality to high inequality group pairings. In order to take this in to account, we include an interaction term of income and social distance variable (INCOME*SOC) in regression [3] . As expected, the interaction term of SOCIAL DISTANCE with INCOME is negative and significant at 1% suggesting that the amount sent tend to be low when low income subjects are paired with other privileged racial groups. If we evaluate the results in Table D2 by differencing whether low income subject or high income subject is matched with other racial groups, we obtain that when low income individuals are matched with a different race of high income groups, the expected reciprocity declines by 1.87%.

In regression [5], the model was also extended with the beliefs of senders in determining experimental trust decision. As one can see, the inclusion of this variables increases the fit of the model. The coefficient on expected trust is positive and significant (1%), suggesting that beliefs of senders about what their counterpart could have sent plays an essential role in determining amount sent. However, unlike

models of reciprocity would predict (c.f. Falk and Fischbacher (2000)), we find that trustor decisions are not correlated with the expectations of being reciprocated. The coefficient on expected trustworthiness is negative and insignificant.

The rest of the individual characteristics that encompass the basic demographics and the attitudinal questions do not have any significant effect on predicting the amount sent. Variables like GENDER, RACE, INCOME, EDUCATION, TRUST INDEX, PERCEPTION INDEX and questions related to the existence of equal opportunity have no effect on experimental trust. The next sub-section attempts to figure out the determinants of trustworthy behavior of subjects under complete information.

3.4.2 Amount returned

We also examine the effect of individual characteristics on the amount returned by the responders. Responders were asked to play strategy method by which they decide how much they will give back for each of the 11 possible amounts they could receive from the sender. It implies that we observe a set of amount returned for each individual i.e. $r_{it} \epsilon\ [0,1]$ where $t_\theta\ \epsilon\ \{1,...,11\}$ is the available options and $\theta\ \epsilon\ \{20,26,...,80\}$ is available amount and r denotes the return ratio (amount returned out of available amount). In order to assess the determinants of fraction returned for each individuals i across set of possible amounts that responders have a panel data is used. We use two variants of estimation methods i.e. the pooled Tobit estimator and Random effects Tobit model. The pooled estimator can be used to obtain a consistent estimator of the estimates using the following model:

$$r_{it} = x'_{it}\beta + \alpha_1\theta_t + \alpha_2\theta_t^2 + v_{i_t},\ t = 1,2,...11 \tag{3.3}$$

where (x_i) denotes background characteristics, β vector of coefficients to be estimated, α_1 and α_2 are the coefficients to be estimated. The squared term (θ^2) is included to take in to account the concavity of the observed relationship between amount available and the amount reciprocated. Moreover, $v_{i_t} \equiv \varepsilon_i + u_{it}$ are the composite errors. For each t, v_{i_t} is the sum of the unobserved individual effect

and an idiosyncratic error. Pooled OLS estimation of this equation is consistent if $E(x_{it}v_{i_t}) = 0$. However, pooled estimator could be inconsistent if the composite errors are serially correlated due to the presence of unobserved effect in each case. Therefore, inference using pooled estimate requires the robust variance matrix that can be used by random effects estimator which additionally required that $E(v_{i_t} \mid x_{it}) = 0$.

Note that our exogenous variables (x_i) vary between individuals, but do not vary over time within a given individual (e.g., gender, race, parents income etc.). The parameters of the individual specific variables (x_i) cannot be estimate in the fixed effects model (that is, we cannot distinguish between observed and unobserved heterogeneity i.e. they will be removed by transformation). The random effects model therefore has the added advantage of allowing us to estimate parameters of which we are interested. For the random effects model to be appropriate, however, the observed heterogeneity (x_i) must be independent of the unobserved heterogeneity (v_i).

The variable r_{it} in equation (3.3) is a latent variable, which represents an unobservable fraction returned by an individual to return some non-zero amounts to a potential partner j from the available options t. As one can see from figure 3 in Appendix B., there was no responder who send his entire available amount, however 11.4% of the total observations state that they could give nothing if they don't get anything from the sender. To analyze responders decisions of the return ratio (controlling for unobserved values smaller than zero), we construct the observable left-censored variable r_{it} in the estimation as:

$$r_{it} = \begin{cases} r^*_{it} \text{ if } r^*_{it} > 0 \\ 0 \text{ if } r^*_{it} \leq 0 \end{cases} \tag{3.4}$$

Equation 3.4 allows a positive probability for sending a zero amount. Alternatively, it suggests that all values of the dependent variable that takes a value of 0 and below are censored at 0. As a result we have 183 left censored observations at $r^*_{it} \leq 0$.

Table D2 contains the results of regressions where the dependent variable is the return ratio. Column (1) of Table D2 pooled the data across the 11 available options

while the column (2) reports estimates of random effects model. Since more than half of the total unexplained variance is due individual effects there is a random component. The estimated rho (ρ) which reflects the relative importance of the variance of individual effects in relation to the total variance is significantly different from zero. In order to take the relative importance of the variance of unobserved effect, we focus, our interpretation in Column 2 of Table D2 that estimates the regressions using random effects Tobit model.

The result of the Censored-Tobit estimate shows, similar to many experimental results, amount returned is positively correlated to the available amount subjects have to return. Thus, the subjects' return behaviour is significantly different from the prediction of completely-selfish subgame perfect equilibrium. This is observed from the Tobit estimates, where θ is positive and the squared term of the variable (θ^2) is negative and both are statistically significant at 1% level, indicating that the probability of reciprocating increases with an increase in the availability of money received though it increases at a decreasing rate. Thus, other things the same, a one unit increase in θ per individual will raise the probability of trustworthiness by about 0.2%.

Subjects from low income families tend to reciprocate 1.2% less than those with high income families, assuming other things remaining constant. This effect is captured by the negative and statistically significant coefficient of "INCOME" variable. The variable "INCOME-HETRO", which captures when individuals are paired with different income groups, is negative and significant. Examination of the effect of "RACE HETRO" variable on trustworthiness reveals that it has a positive and statistically significant (5%) effect in explaining the observed behavior. That's controlling for income differences, heterogeneity in race does not hamper the level of trustworthiness behavior in South Africa. Observe that the only negative effect of race arises when it is accompanied with income difference. The "SOCIAL DISTANCE" variable captures when subjects are matched not with their own group both in race and income. We also include an interaction variable that captures the negative effect of income inequality on the propensity to reciprocate. This effect is entirely captured by the interaction variable INCOME*SOC. The inclusion of this

variable significantly improves the fit of the model. The only exception is that the coefficient for "SOCIAL DISTANCE" changes its sign from negative to positive. In order to see the net effect of social distance, we take the discrete change of the $INCOME$ variable with the propensity to trustworthiness. If we evaluate the results in Table D2 by differencing when a low income subject subject is matched with other racial groups and high income groups, we obtain that the probability of reciprocating reduces by 2.5%.

Questions about equal opportunity and economic position are taken from World Value Survey (WVS); the variables are categorical responses to the following questions: If someone has a high social or economic position, do you agree strongly [4], agree somewhat [3], disagree somewhat [2], disagree strongly [1] that indicates the person has special abilities or great accomplishments? Does everyone in this country have an opportunity to obtain an education corresponding to his or her abilities and talents? [1]Yes [0] No. The perception index which is an indicator variable whether inequality is generated fairly or not, is related positively to trustworthiness level in South Africa. Individuals who believe that economic position is based on ability rather than by unfair means in South Africa, returned a higher amount than otherwise. The variable "PERCEPTION INDEX" is positive and significant (5%).

Similar to Glaeser *et al.* (2000), we also find strong evidence between the WVS trust question and the ratio of money returned. We find a positive relationship between the level of trustworthiness and trust index suggesting that attitudinal trust questions can predict trustworthiness behavior (WVS Helpful, Fair and Trust). Moreover, we also find that expected trustworthiness variable is positively correlated with the fraction returned and is significant at (1%) level. The impact of this variable suggests that trustworthiness also is based on expectations about people's trustworthiness.

3.5 Concluding Remarks

We reported the results of a series of experimental trust games conducted in South Africa focusing on the effects of racial and income inequality on the trust level. Despite the extreme heterogeneity of South African society, in terms of race and income, we find that the general level of trust and trustworthiness is similar to more homogenous societies, i.e. when subjects do not have information on the partner they are playing with, they do not behave differently from subjects in other parts of the world.

Information on race and income characteristics of the subjects' partner has an effect on subjects' behavior, though. Subjects show mistrust or discrimination towards subjects from other groups. However, what we firmly could reject is that these types of behavior were driven by racial discrimination. To the contrary, what we found was a kind of cross-ethnical jealousy effect from the disadvantaged (low income) subjects of both racial groups. In particular, low-income white subjects showed mistrust against high-income black subjects, i.e., they sent low amounts of money to these subjects as they expected a low return on their investment. Black low-income subjects, on the other hand, showed signs of discrimination regarding the white high-income subjects, i.e. they sent little to this group not because they expected less in return, but apparently because of a dislike for this group.

Somewhat striking is that black high-income subjects showed a taste for discriminating black low-income subjects, i.e. they sent them low amounts of money although they did not expect a low return. It looks like the more economically successful black subjects have a desire to insulate themselves from their less well off racial brothers and sisters. It is, moreover, ironic to note here that those who were once discriminated by the state, i.e. the disadvantaged black subjects, are now, in their turn, discriminating subjects descending from the former rulers, i.e. the advantaged whites. On the positive side, we did not observe any inclination of white high-income subjects to discriminate against other groups.

Similar to GLSS (2000) results, our experimentally derived measure of trustworthiness was significantly predicted by the answers on survey questions about trust.

Moreover, similar to Barr's (2003) results from Tanzanian communities, we found that trustworthiness behavior is motivated by expectations of trustworthiness. Finally, we also found that the propensity to reciprocate is significantly related on the questions related to whether economic achievements are determined fairly or not.

The experiment offered us an opportunity to address the issue of race and income inequality that is believed to affect the level of trust. Discrimination, if it exists, is based on envy of economic achievements of individuals from the other race. If racial fragmentation is not prominently bold, then narrowing income differences could help in promoting trusting behavior. In other words, to take away this type of non-cooperative and non-productive behavior, economic policy addressing the existing inequalities is needed.

Appendix to Chapter 3

3A. Appendix: Instruction Welcome to our experiment, which is part of a research project of Tilburg University in cooperation with the North West University. In this experiment you can earn real money that will be paid to you privately in cash at the end of the experiment. Because participants take part in the experiment at different times and places, the experiment may not end today. After the session, we will inform you when and where you can pick up your payoff. How much money you will receive in the end depends on your decisions and the decisions of other participants of the experiment.

We will read these instructions together. After this you will have ample opportunity to ask questions. If you have a question by then, please raise your hand and we will help you.

Description

In this experiment, you will be randomly matched to another participant. Both of you start with an endowment of 20 Rand. Each of you will decide what amount of money to transfer to the other. You will decide one after the other. The first to decide is called player A, the second to decide is called player B. For now you do not know whether you are player A or B. You will be informed later.

If you are player A, you will decide how much of your initial endowment (20 Rand) you want to transfer to player B. The amount that you transfer to player B must be an even number that means a number from the set {0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20}. Your transfer to B will be tripled by the experimenter. For example, if you are player A and transfer 4 Rand to player B, the amount that B will actually receive is 3 x 4 = 12 Rand. Note that you can decide not to transfer money to player B. If you do not, then nothing is tripled and each of you will have the original 20 Rand to take home.

If you are player B, you will receive the tripled amount of money that was transferred to you by player A. This tripled amount is added to your initial endowment of 20 Rand. For example, if you are player B and player A has transferred 4 Rand to you, then you will have total amount of 20 + 12 = 32 Rand. Now, you can decide to transfer some part of your total earnings to A. Your transfer to A is not tripled. The remaining part of your total earnings (the amount that you did not transfer to A) is your payoff of

the experiment. Note that you can decide not to transfer money to player A. If you do not, then you will have your total earnings to take home, while A will have the original endowment minus the transfer made to you.

Decision Form (with information on partner)

This is the decision form that you must fill out. You will make decisions both for the role as player A and as player B. A random draw will later determine whether you are actually player A or player B.

Upon registration, the participant to whom you are matched has provided the following information*):

Race [ ] black [ ] white [ ] other

Family Income [ ] below average [ ] above average

The corresponding information that you have provided is also given to the participant you are matched with.

Suppose you are player A

Please, fill in your decisions as player A on the blanks in the lines 1) and 2).

1) Your transfer to player B is _____ Rand

Remember that you may only choose an even number.

So, you may choose from: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, or 20.

2) You expect B to transfer to you _____ Rand

Suppose you are player B

The table below lists all possible amounts that player A may send to you. If you are randomly determined to be player B, only one of these amounts will actually count, namely the one that was chosen by the player A who is matched to you. But, since for now you do not know which amount will actually be chosen by player A, you must make a transfer decision for every possible amount.

A transfers	0	2	4	6	8	10	12	14	16	18	20
A retains	20	18	16	14	12	10	8	6	4	2	0
B receives	0	6	12	18	24	30	36	42	48	54	60
B has	20	26	32	38	44	50	56	62	68	74	80
B transfers											
	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

Please, fill in a transfer to *A* in each of these empty cells.

Make sure that the transfer you fill in is not greater than the amount in the cell immediately above it.

You expect A to transfer to you _____ Rand

Remember that A may only choose an even number.

So, A may choose from: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, or 20.

3B. Appendix.

Table B1. Average amount sent, returned and expectations about reciprocity and trust (Figures are in %).

		Receiving Subjects			
Sending Subjects	No Info.	BL	BH	WL	WH
BL	56.00	64.05	44.65	41.30	30.00
BH	10.00	25.00	-	-	65.00
WL	60.00	47.50	17.15	55.71	52.00
WH	56.25	70.00	47.50	67.00	51.80
		Returning Subjects			
Anticipating return	No Info.	BL	BH	WL	WH
BL	30.93	37.57	37.07	38.80	37.90
BH	77.00	40.67	-	-	38.50
WL	33.25	24.00	20.29	33.00	50.10
WH	33.25	27.11	40.00	38.80	38.23
		Receiving Subjects			
Returning	No Info.	BL	BH	WL	WH
BL	29.65	27.96	25.21	35.92	21.63
BH	9.00	26.58	-	-	27.43
WL	25.75	26.82	18.58	26.14	32.72
WH	29.50	41.03	27.07	32.72	30.76
		Sending Subjects			
Anticipating amt. sent	No Info.	BL	BH	WL	WH
BL	62.00	72.85	62.00	52.00	53.25
BH	10.00	42.50	-	-	69.15
WL	70.00	67.50	45.51	88.51	67.00
WH	61.25	60.00	47.50	74.00	56.35

.

Table B2. Differences in the average amounts of subject's decisions between complete and no information treatment.

Treatments	Amount sent	Anticipated return	Amount returned	Anticipated amt sent
		Black Lows (BL)		
BLNI- BLBL	15.35 [0.222]	-6.64 [0.524]	1.69 [0.840]	-10.85 [0.521]
BLNI -BLBH	11.35 [0.354]	-6.14 [0.770]	4.44 [0.580]	0.00 [0.820]
BLNI- BLWL	14.70 [0.249]	-7.87 [0.410]	-6.27[0.320]	10.00 [0.410]
BLNI -BLWH	26.00 [0.018]**	-6.97 [0.490]	8.02 [0.250]	8.75 [0.360]
		White Lows (WL)		
WLNI - WLWH	8.00 [0.796]	-16.85 [0.323]	-6.97 [0.730]	3.00 [0.970]
WLNI -WLWL	4.29 [0.000]***	0.25 [0.821]	-0.39 [1.000]	18.51 [0.194]
WLNI -WLBH	42.85 [0.006]***	12.96 [0.106]	7.17 [0.527]	24.29[0.260]
WLNI -WLBL	12.50 [0.800]	9.25 [0.486]	-1.07 [0.686]	2.50 [1.000]
		White Highs(WH)		
WHNI-WHBL	13.75 [0.318]	6.14 [0.308]	-11.44 [0.475]	1.25 [0.943]
WHNI WHBH	8.75 [0.364]	6.75 [0.333]	2.52 [0.434]	13.75 [0.267]
WHNI-WHWL	-10.75 [0.641]	-5.55 [0.680]	-3.13 [0.759]	-12.75 [0.210]
WHNI-WHWH	4.41 [0.576]	-4.98 [0.477]	-1.17 [0.920]	4.90 [0.953]

The entries give the difference in the average values (in terms of percentages) of the returned and expectations under no information. The numbers in the brackets represent Mann-Whitney U-test and *, ** *** denote significant level at 10%, 5% and 1% respectively.

Table B3: Differences in Expected Payoffs with respective treatments

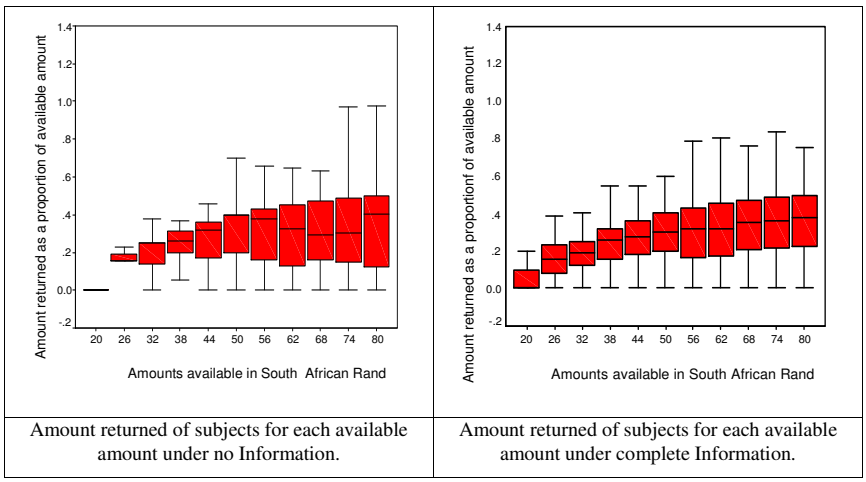
Treatments	Ex. as a Sender	Ex. as a receiver	Ex.Payoff
Pure Racial Effect			
BLBL-BLWL	-0.44 (0.894)	-3.36 (0.361)	-1.90 (0.351)
WLWL-WLBL	-6.94 (0.003)***	6.37 (0.164)	-0.28(0.927)
WHWH-WHBH	2.49 (0.359)	-4.52 (0.198)	-1.01(0.762)
Pure Income Effect			
BLBL-BLBH	-0.91 (0.675)	5.38 (0.000)***	2.23 (0.026)**
WLWL-WLWH	5.23 (0.000)***	1.02 (0.607)	3.12 (0.202)
WHWH-WHWL	0.65 (0.663)	1.01 (0.545)	0.83 (0.973)
Interaction of Racial and Income Effect			
BLWL-BLBH	-1.35 (0.429)	2.02 (0.117)	0.33 (0.690)
BLWH-BLBH	4.57 (0.007)***	20.22 (0.000)***	12.39 (0.000)***
BLWH-BLBL	5.48 (0.000)***	14.83 (0.000)***	10.16 (0.000)***
BLWH-BLWL	5.92 (0.000)***	18.19 (0.000)***	12.05 (0.000)***
BHWH-BHBL	4.91 (0.002)***	1.70 (0.937)	3.30 (0.394)
WLWH-WLBL	-1.71 (0.288)	7.39 (0.188)	2.84 (0.454)
WHWH-WHBL	6.30 (0.000)***	11.97 (0.009)***	9.14 (0.001)***
WHWL-WHBH	1.84 (0.013)***	-5.52 (0.501)	-1.84 (0.878)
WHWL-WHBL	5.65 (0.000)***	10.97 (0.003)***	8.31 (0.001)***
WHBH-WHBL	3.81 (0.000)***	16.49 (0.000)***	10.15 (0.000)***

The entries give earning differentials in terms of ZAF$ between respective treatments as senders, receivers and as players under complete information. The numbers in the brackets represent p-values of the Mann-Whitney U-test. *, ** and *** denote significant at 10%, 5% and 1% respectively.

Table B4. Differences in expected payoffs between no information and complete information treatment.

Treatments	Ex. as a Sender	Ex. as a receiver	Ex.Payoff
		Black Lows (BL)	
BLNI- BLBL	1.30 (0.116)	2.54 (0.340)	1.92 (0.106)
BLNI -BLBH	0.39 (0.631)	7.92 (0.001)***	-4.15 (0.010)***
BLNI- BLWL	1.74 (0.018)***	5.90 (0.079)*	3.82 (0.074)*
BLNI -BLWH	-4.18 (0.000)***	-12.30 (0.001)***	-8.24 (0.000)***
		White Lows (WL)	
WLNI - WLWH	-3.18 (0.428)	0.00 (0.733)	-0.02 (0.539)
WLNI -WLWL	2.05 (0.003)***	0.70 (0.927)	1.37 (0.412)
WLNI -WLBL	-4.89 (0.029)**	7.07 (0.200)	1.09 (0.886)
		White Highs (WH)	
WHNI-WHBL	5.63 (0.000)***	14.01 (0.000)***	9.82 (0.000)***
WHNI WHBH	1.81 (0.010)***	-2.48 (0.223)	-0.33 (0.777)
WHNI-WHWL	-0.03 (0.159)	3.04 (0.945)	1.51 (1.000)
WHNI-WHWH	-0.68 (0.529)	0.02 (0.717)	0.01 (0.778)

The entries give earning differentials in terms of ZAF$ between respective treatments as senders, receivers and players when one compares no information with complete information. The numbers in the brackets represent p- value of the Mann-Whitney U-test and *, ** *** denote significant at 10%, 5% and 1% respectively.



Amount returned of subjects for each available amount under no Information.

Amount returned of subjects for each available amount under complete Information.

Figure 3B. Box Plot of amount returned.

Table C1. Definition of variables and summary statistics

VARIABLES	Mean	StD	Definition of variables used
GENDER	0.473	0.450	Dummy 1 if Male
RACE	0.459	0.498	Dummy 1 if White
INCOME	0.646	0.479	Dummy 1 if family income is below average
EDUCATION	0.465	.500	Dummy 1 if parents education is degree
PERCEPTION	2.850	0.869	Index of equality in economic positions
OPPORTUNITY	0.479	0.500	Dummy 1 if equality in opportunity
TRUST INDEX	0.706	0.707	Index of GSS fair, trust and help
INCOME-HETRO	0.534	0.500	Dummy 1 if match is different in income
RACE-HETRO	0.479	0.500	Dummy 1 if match is different in race
AMOUNT SENT	0.451	0.321	Amount sent out of available stake
RETURN RATIO	0.285	0.224	Amount returned out of available amount
Ex.Trustworthiness	0.367	0.207	Expected return out of available amount
Ex.Trust	0.606	0.311	Expected amount sent out of available amount
SOCIAL DISTANCE	0.250	0.433	Interaction term for INCOME-HETRO x RACE-HETRO
INCOME*SOC	0.187	0.390	Interaction term for INCOME x SOCIAL DISTANCE

Table D1. Double-Censored Tobit Estimates on the Amount Sent

	1	2	3	4	5
CONSTANT	0.547	0.525	0.493	0.604	0.198
	(0.089)***	(0.111)***	(0.109)***	(0.181)***	(0.176)
GENDER	-0.062	-0.059	-0.069	-0.063	-0.049
	(0.071)	(0.071)	(0.069)	(0.074)	(0.063)
INCOME	-0.161	-0.144	-0.062	-0.050	-0.124
	(0.081)**	(0.082)*	(0.086)	(0.091)	(0.078)
RACE	0.120	0.127	0.096	0.082	0.046
	(0.078)	(0.078)	(0.077)	(0.084)	(0.070)
INCOME-HETRO		0.056	0.057	0.081	0.141
		(0.098)	(0.096)	(0.097)	(0.084)*
RACE-HETRO		0.034	0.034	0.035	0.137
		(0.104)	(0.101	(0.102)	(0.088)
SOCIAL DISTANCE		-0.161	0.179	0.171	0.055
		(0.143)	(0.194)	(0.195)	(0.169)
INCOME*SOC			-0.462	-0.487	-0.372
			(0.184)***	(0.189)***	(0.161)**
PERCEPTIONS				-0.047	-0.050
				(0.041)	(0.036)
OPPORTUNITY				0.023	-0.010
				(0.074)	(0.062)
EDUCATION				0.054	0.046
				(0.084)	(0.071)
TRUST INDEX				-0.034	-0.034
				(0.051)	(0.044)
Ex.Trustworthiness					-0.054
					(0.161)
Ex. Trust					0.716
					(0.106)***
$\widehat{\sigma}$	0.412	0.409	0.398	0.397	0.331
	(0.031)***	(0.031)***	(0.030)***	(0.030)***	(0.025)***
Observations	144	144	144	143	141
Log likelihood	-99.919	-98.988	-95.863	-94.656	-69.322
Wald Test (χ^2)	11.24	13.10	19.35	21.60	68.10

Numbers in parentheses beneath parameter estimates are the estimated standard errors.

*, ** *** denote significant at 10%, 5% and 1% respectively.

Table D2. Single Censored Tobit Estimates of the RETURN RATIO

	Pooled Estimates (1)		Random Effects (2)	
	Coeff.	S. error	Coeff.	S. error
CONSTANT	-0.378	(0.057)***	-0.198	(0.041)***
θ	0.017	(0.002)***	0.015	(0.001)***
θ^2	-0.0001	(.00002)***	-0.0001	(.00001)***
GENDER	0.016	(0.013)	0.004	(0.012)
INCOME	-0.011	(0.016)	-0.066	(0.014)***
RACE	0.015	(0.014)	-0.020	(0.013)
INCOME-HETRO	-0.008	(0.017)	-0.035	(0.014)**
RACE-HETRO	0.042	(0.018)**	0.046	(0.016)**
SOCIAL-DISTANCE	0.105	(0.033)**	0.102	(0.026)**
INCOME*SOC	-0.203	(0.031)***	-0.178	(0.025)**
PERCEPTION INDEX	0.020	(0.007)***	0.010	(0.005)**
OPPORTUNITY	-0.017	(0.013)	-0.021	(0.013)
EDUCATION	-0.030	(0.014)***	-0.008	(0.012)
TRUST INDEX	0.032	(0.009)***	0.020	(0.008)***
Ex.Trustworthiness	0.167	(0.030)***	0.212	(0.023)***
Ex.Trust	0.043	(0.020)***	0.019	(0.008)
$\widehat{\sigma}$	0.224	(0.004)***		
$\hat{\sigma}_{\varepsilon}$			0.174	(0.004)***
$\hat{\sigma}_{u}$			0.135	(0.003)***
Rho			0.624	(0.015)***
Observations	1550		1550	
Log likelihood	-62.955		462.46	
Wald Test (χ^2)	357.42		760.77	

*, ** *** denote significant at 10%, 5% and 1% respectively.

Part II Theoretical and Model-Driven

Chapter 4

Inequality, Taxation and Economic Growth

4.1 Introduction

Traditionally, economists assume a trade-off between inequality and growth. Papers like Bertola (1993), Alesina and Rodrik (1994); Persson and Tabellini (1994), for example, provide an explanation for such a negative relationship. Using political economy models that rely extensively on the median voter theorem, they show that greater skewness in the distribution of income leads to more redistribution in democratic societies. High redistribution in turn generates disincentives for capital accumulation and growth. However, the evidence for a negative relationship between growth and redistribution is weak. In fact, the relation seems to be non-monotonic. Perotti (1996), for example, finds a positive relationship between redistribution and growth using marginal tax rates, social security/welfare spending and expenses on housing and health as redistribution measures. Rodriguez (1999) finds that pretax inequality has a significantly negative effect on transfers as well as the capital tax rates. Moreover, Figini (1999) found evidence for reverse causality, i.e. redistribution is lower when there is more inequality. Saint Paul and Verdier (1993) and Aghion and Bolton (1997) provide a theoretical underpinning for a positive relationship between redistribution and growth arguing that in more

unequal societies redistribution stimulates growth as it enhances opportunities to invest in human capital accumulation and profitable projects.

In this chapter, we present a political economy model of redistribution which allows for a non-monotonic relationship between redistribution as measured by the tax rate and growth. Unlike the above mentioned political economy models, our model does not rely on the median voter theorem. Instead, we use a pressure group model, assuming active participation of potential voters in the form of lobbying to influence policies. Such activities are a common practice in democracies and often require real resources which would otherwise be utilized in direct production (see Rodriguez, 2000). For example, politically active groups invest time in various political activities, strikes, working on campaigns, writing Congress, lockouts etcetera. In line with this, we assume that individuals invest time to influence the political outcome, i.e. the level of redistribution.[1] While it is apparent that we cannot say too much about the details of political activity, this assumption allows us to link the level of redistribution to economic variables like differences in opportunity cost of time between groups of agents.

Our research is not, of course, the first to examine the non-positive relationship between inequality, redistribution and growth. Benabou (2000) assumes that there exists a wealth bias in the political system and that therefore the decisive voter has a higher income than the median voter. If his income is sufficiently high, then redistribution will raise his cost and hence he will oppose higher taxation. Benabou's idea is indeed a relevant point, but his model does not explain what determines the position of the decisive voter and how it changes over time. This is exactly what we want to solve in the present paper by investigating a model where the pressure for redistribution changes endogenously during the interaction of economic agents and the growth process over time. Bourguignon and Verdier (2000) also present a model of endogenous political participation. In their model agents can participate in political decision making only if they are educated, i.e.

[1]The studies of voter behavior indicate that political activity depends on the state of the macro-economy. For example Radcliff (1992) and Filer *et al.* (1993) found that as real wage falls, mobilization tends to rise and as a consequence voter turn out tend to increase.

political power is asymmetrical by assumption.[2] Our model, in contrast, does not assume ex ante that the possibilities to influence political decision making are asymmetrical. The outcome of the political decision process may be asymmetrical ex post, however, for example as a result of differences in the investment of time in lobbying due to differences in opportunity costs, but also as a result of differences in the size of the groups.

The aim of this chapter is to study the process by which support and opposition to redistribution emerges in a dynamic context. We develop a model of a small open economy with overlapping generations and inter-generational altruism (from parents to children). Agents with two-period lives decide whether or not to invest in human capital, and all who invest acquire the same level of knowledge. Heterogeneity arises simply because of differences in inherited wealth which produces inefficiency in investing in human capital, as the unskilled cannot afford to invest in becoming skilled due to capital market imperfections. This will lead to a rich dynasty in which each generation invests in human capital and leaves a large bequest and a poor dynasty that remains unskilled and leaves a lower bequest to their children. It is important to note that investment in human capital is indivisible as in Galor and Zeira (1993), which in turn implies that in the long run there will be polarization of wealth between educated (rich) individuals and uneducated (poor) ones. Long-run income will depend on both the initial wealth distribution and on whether the redistribution scheme helps in mitigating the liquidity constraints of financing education. Initially, there may be a large group of unskilled who have low opportunity costs of time relative to the benefits of lobbying and therefore invest a relatively large amount of time in lobbying. This will result in a relatively high level of redistribution, which may enable some children of uneducated parents to pass the threshold cost of education. This will increase the relative size of the group of skilled and raise the opposition to redistribution. These two opposing forces, i.e. the *cost-benefit effect* and the *group size effect* may explain the nonmonotonicity of redistribution and growth (wealth distribution). A steady state prevails if the

[2]It implies that higher inequality could lead to lower redistribution as the rich people are the only participants.

two effects cancel out. This steady state is not necessarily unique, however, but may depend upon the initial distribution of wealth.

We will show that in the presence of investment indivisibilities in human capital and rigidities in capital markets, both the pressure for redistribution and the initial wealth distribution affect economic growth. Growth is mainly determined by human capital accumulation in both sectors.[3] Technical knowledge is endogenous, as the knowledge production exhibits both learning-by-doing and knowledge spill overs. Because of spill-over effects between the skilled and the unskilled sector, the long run-growth rate in both sectors is equal. We show that the long-run growth rate depends on the size of both sectors and therefore on redistribution. We derive a non-monotonic relation between the redistributive tax rate and long-run growth. The resulting relationships are explored both theoretically and quantitatively. In particular, we present numerical simulation experiments that illustrate the dynamic adjustment process towards a steady state after a technological shock that increases the wage gap between skilled and unskilled workers and after a redistribution of initial wealth. The simulations show that in both cases the number of skilled and growth eventually rise. This goes along with a lower tax and a larger wage gap in the long-run.

We proceed as follows. We first introduce the economy by specifying production, preferences, the extent of redistribution and how this redistribution is determined endogenously. In Section 4.2, we also analyze the immediate effects of an increase in the productivity of skilled workers on pressure for redistribution. Section 4.3 examines the dynamics of bequests and redistribution. Section 4.4 explains the non-monotonicity of the relation between redistribution and growth. In Section 4.5 we present some numerical simulation results. In particular, we illustrate how the economy reacts to an unanticipated increase in the productivity of skilled workers

[3] This is particularly true given that the genesis of growth seems to have changed substantially across time. In the words of Williamson (1991, p.90) " the mode of accumulation in the nineteenth century appears to have been much more heavily directed towards conventional capital formation, while the mode of accumulation in the twentieth century seems to have been much more heavily directed towards human capital accumulation."

in the short run as well as in the long run and how a change in the initial wealth distribution affects long-run growth. The last section concludes. All proofs are gathered in the Appendix.

4.2 The Model

In this section we describe the economics, politics and the dynamic structure of the society at hand. We introduce a standard two-OLG model of a small open economy where parents are altruistic and leave bequests. We first present a brief description of the technology and behavior of households given the political institutions. Subsequently we elaborate on the political process.

4.2.1 The Technology

There is a single good that can be produced with a simple linear technology using skilled labour S_t and unskilled labour U_t :

$$Y_t = A_t^u U_t + A_t^s S_t \tag{4.1}$$

Each type of labour is paid its marginal product, that is, $w_t^u = A_t^u$ and $w_t^s = A_t^s$. It is assumed that high skilled labour is more productive than unskilled labour: $w_t^s > w_t^u$. We assume that there is a continuum of knowledge innovations that increases production by skilled and unskilled via learning by doing. That is, knowledge creation is driven by production by skilled and unskilled workers and there are spill overs from one type of workers to the other:

$$\begin{cases} \Delta A_t^s = \theta^s \left(A_t^s S_t\right)^{\phi} \left(A_t^u U_t\right)^{1-\phi} \\ \Delta A_t^u = \theta^u \left(A_t^s S_t\right)^{\pi} \left(A_t^u U_t\right)^{1-\pi} \end{cases} \tag{4.2}$$

The parameters ϕ and π reflect the effect of production (and thus of the existing stock of knowledge) on the success of new knowledge production. We assume that skilled production is more important for the creation of knowledge of the skilled workers than unskilled production (i.e. $0.5 < \phi < 1$) and that the spillover from skilled workers to the unskilled is larger than the spillover from unskilled workers

to the skilled (i.e. $\pi > 1 - \phi$). Note that because of the spill overs, the growth rate of wages of skilled and unskilled workers ($\frac{\Delta A_t^s}{A_t^s}$ and $\frac{\Delta A_t^u}{A_t^u}$ respectively) will be the same in the long run though the levels of A_t^s and A_t^u will be different[4]. From this we can derive that in the steady state:

$$\frac{A_t^s}{A_t^u} = \left(\frac{\theta^s}{\theta^u}\right)^{\frac{1}{1+\pi-\phi}} \left(\frac{S}{U}\right)^{\frac{\phi-\pi}{1+\pi-\phi}} \tag{4.3}$$

Plugging this in equation (4.2) gives the following expression for long-run growth:

$$g = \theta^s S \left(\frac{\theta^s}{\theta^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{S}{U}\right)^{\frac{\phi-1}{1+\pi-\phi}}. \tag{4.4}$$

Note that the assumptions imply that both production by skilled workers and by unskilled workers raises long-run growth, but that the elasticity of growth with respect to an increase in skilled production is larger than the elasticity with respect to an increase in unskilled production.

4.2.2 The Households

The economy is populated by overlapping generations of individuals, each living for two periods. Each agent has one child, hence the population, N, is constant. Agents consume only in the second period of their life. Furthermore, we will assume that parents are altruistic, i.e. members of a dynasty are linked through bequests left to their children. Agents of a generation differ in the amount that they have inherited from their parents, but are the same in their preferences and abilities. Utility of an agent born in period t is assumed to be a logarithmic function of consumption in the second period of his life (c_{t+1}) and the bequest left to his child (b_{t+1}):

$$V_t = \alpha \log c_{t+1} + (1-\alpha) \log b_{t+1}, \text{where } 0 < \alpha < 1 \tag{4.5}$$

In the second period of their life, individuals are endowed with one unit of time each that they can spend either on working (l_t) or on lobbying activities (γ_t). That

[4]See Appendix A.1. for the explanation that if there exist steady state growth, it must be the case that growth rates in both sectors are equal.

is,

$$\gamma_t + l_t = 1 \tag{4.6}$$

Agents can work as a skilled labourer in the second period of their life if they invest in human capital during the first period. The investment in human capital is indivisible: that is either one invests $h_t > 0$ or one does not invest at all.[5] All investment must be financed out of inheritances, i.e. there is no capital market and hence agents can not borrow against future earnings to finance expenditures on education when young.[6] So only agents with an inheritance $b_t^i \geq h_t$ are able to become skilled. We denote by N_t^s the number of skilled individuals in period t and by $N_t^u = N - N_t^s$ the number of individuals of the same generation (i.e. born in period $t-1$) who remain unskilled. For all other variables we also distinguish between skilled and unskilled agents by the superscript s and u respectively. So the supply of skilled labour is $S_t = N_t^s l_t^s$ and the supply of unskilled labour is $U_t = N_t^u l_t^u$.

The government runs a redistribution scheme from the skilled to the unskilled of the same generation as a balanced budget scheme, financed by a tax on wage income of the skilled:

$$\lambda_t = (\frac{N_t^s}{N_t^u})\tau_t w_t^s l_t^s \tag{4.7}$$

where τ_t is the labour income tax.

In the second period of their life, the unskilled consume a part α of their wage income, their bequest plus returns and the transfer payments λ_t, while the rest is left as a bequest. So consumption and bequest for the unskilled is given by :

$$c_t^u = \alpha \left[b_{t-1} (1 + r) + w_t^u l_t^u + \lambda_t \right], \tag{4.8}$$

$$b_t^u = (1 - \alpha) \left[b_{t-1} (1 + r) + w_t^u l_t^u + \lambda_t \right] \tag{4.9}$$

[5] This model is perhaps best viewed as concerning the investment in higher education as affordability is not generally an issue at the primary school of education. It is assumed that the costs of education are proportional to the wage of skilled workers, i.e.. $h_t \equiv \varkappa A_t^s$.

[6] Empirical evidence has shown the existence of market failures in financing education. We do not model this market imperfections as this would complicate the model without changing the result. Moreover, credit on investment in human capital is constrained since embodied human capital is viewed as poor collateral by lenders. See Flug *et al.* (1998) for evidence.

where r is the exogenous interest rate determined in world capital markets.

Unlike the unskilled, the skilled invest in human capital in the first period and receive a net wage of $(1-\tau_t)w_t^s$ in the second period. The consumption of a skilled agent is thus given by:

$$c_t^s = \alpha\left[(b_{t-1}-h_{t-1})(1+r)+(1-\tau_t)w_t^s l_t^s\right] \tag{4.10}$$

and the bequest they leave is:

$$b_t^s = (1-\alpha)\left[(b_{t-1}-h_{t-1})(1+r)+(1-\tau_t)w_t^s l_t^s\right] \tag{4.11}$$

We assume that all individuals prefer to work as skilled, i.e. we assume $V^s > V^u$, which implies:[7]

$$w_t^s l_t^s > h_{t-1}(1+r) + w_t^u l_t^u + \tau_t w_t^s l_t^s \left(1+\frac{N_t^s}{N_t^u}\right) \tag{4.12}$$

4.2.3 Redistributive Lobbying

The purpose of this subsection is to link household heterogeneity to redistributive lobbying. This is accomplished by assuming that in the second period of their life, agents invest time to influence the government. In doing so they implicitly choose the tax rate of the redistribution schedule. It is important to note that we abstract from commitment and persistence. That is, each period the tax rate is determined independently from the tax rates in previous or future periods.

Of course, the notion of political lobbying is not new. A variety of static models that deal with lobbying and the related issue of endogenous policy exist, particularly in the field of international trade, for example Kruger (1974) and Das (1990), to name but few. Our model of the political process is similar to Becker (1983; 1985) and Kristov *et al.* (1992).[8] However, these papers typically neglect dynamic

[7] Note that this condition involves several endogenous variables. Consequently, it can not be assumed to hold ex ante. Instead, we checked the simulation results to verify that the condition holds ex post throughout the whole time path.

[8] Most recent contributions that apply this influence function approach to the politics of inter generational redistribution are Becker and Mulligan (1998), Mulligan and Sala-i-Martin (1999) and Theo (2001).

issues and focus on endogenous policy model with interest groups of a fixed size.

It is assumed that the government does not play an active role in the political process but is captured by the special interests of the skilled and the unskilled. We neglect within-group differences and assume that the common interest of each of the groups is represented by a lobby group. Moreover, we abstract from free riding effects and assume that each group chooses the amount of time that its members invest in influencing the redistributive policy so as to maximize the group members' lifetime utility. Thus at any time t, the redistributive tax on the skilled is determined by a political process that is implicitly described by:

$$\tau_t = \tau(N_t^u, N_t^s, \gamma_t^u, \gamma_t^s) \tag{4.13}$$

So the outcome of the political decision process depends not only on the individual investment of time in lobbying, but also on the size of the groups. The latter is in line with Cameron (1988), who noted that group size reflects a relevant resource in getting political power. Even though Olson (1965) has emphasized the free-rider problems affecting the organization of large groups, recently Acemoglu and Robinson (2001) have shown that larger groups have more influence in political decision making. Therefore, we assume that individual lobby time as well as group size have a positive effect on political influence.

It is assumed that the implicit tax function (4.13) is twice differentiable, with the following first-order and second-order derivatives:

$$\tau_t^u \equiv \frac{\partial \tau_t}{\partial \gamma_t^u} > 0, \ \tau_t^s \equiv \frac{\partial \tau_t}{\partial \gamma_t^s} < 0,$$

$$\tau_t^{uu} \equiv \frac{\partial^2 \tau_t}{(\partial \gamma_t^u)^2} < 0, \ \tau_t^{ss} \equiv \frac{\partial^2 \tau_t}{(\partial \gamma_t^s)^2} > 0, \tau_t^{su} \equiv \frac{\partial^2 \tau_t}{\partial \gamma_t^s \partial \gamma_t^u} \underset{>}{\leq} 0 \tag{4.14}$$

If one group invests more in lobbying, it is *ceteris paribus* more successful in achieving its objective, but the marginal effect of these rent-seeking investments is decreasing in absolute value. The sign of the cross partial derivative is not unambiguously clear. As we will see later on, this cross derivative is a determining factor

for the reaction of one lobby group to changes in the rent seeking activities of the other group.

The following definition, which adopts the terminology of Aidt (1997), characterizes the lobby groups according to their best response towards a change in the political activities of their opponents.

Definition 1 *The type of a lobby group is determined by the slope of group j's best response function. There are three different cases:*

(i) A lobby group i is ***offensive*** *if its best response function is upward sloping,i.e.,* $\frac{d\gamma_t^i}{d\gamma_t^j} > 0, i, j = u, s,\ j \neq i$;

(ii) A lobby group i is ***defensive*** *if its best response function is downward sloping,i.e.,* $\frac{d\gamma_t^i}{d\gamma_t^j} < 0, i, j = u, s,\ j \neq i$;

(iii) A lobby group i is ***passive*** *if its best-response function is horizontal i.e.,* $\frac{d\gamma_t^i}{d\gamma_t^j} = 0, i, j = u, s,\ j \neq i$;

Consider, for example, the first case in the above definition. An increase in the political investment of group i will under these circumstances, increase the marginal lobbying activities of the other lobby group and it will be in the best interest of group j to exploit this and increase its lobbying and hence group j is offensive. A defensive group will (partially) retreat from the political arena if it encounters increased hostile activities. Passive groups do not react at all if the opposition alters its lobbying efforts.

As mentioned above, we assume that each lobby group maximizes the lifetime utility of its group members by choosing the optimal amount of lobbying effort. Moreover, we assume that it takes the decision of its political opponent as given when deciding on the lobby effort. The first-order condition for the lobby group representing the skilled in period t is

$$-\tau_t^s l_t^s = 1 - \tau_t \tag{4.15}$$

The analogous first-order condition for the lobby group representing the unskilled

is

$$\frac{N_t^s}{N_t^u}\tau_t^u w_t^s l_t^s = w_t^u \tag{4.16}$$

Hence, both lobby groups invest in political influence until the marginal effect of lobbying equals the opportunity costs of time, i.e. the (after-tax) wage. For the unskilled, the marginal benefit of lobbying depends on the wage of the skilled as well as on the number of skilled relative to the number of unskilled. As a result, the unskilled will, for example, lobby more if the number of skilled rises. Of course, one group's response to such a change may incite the other group to change its behavior as well, depending on the response functions. As mentioned above, the best response of a group depends on its character, which in turn depends on τ_t^u and τ_t^{su}. The following lemma relates the character of the lobby group to the partial derivatives.

Lemma 1 *The character of the opposing lobby groups and the partial derivatives* τ_t^u *and* τ_t^{su} *are related as follows:*

i) $l_t^s\tau_t^{su} > \tau_t^u \Rightarrow$ *the lobby representing the skilled is defensive and the lobby representing the unskilled is offensive.*

ii) $l_t^s\tau_t^{su} < \tau_t^u \Rightarrow$ *the lobby representing the skilled is offensive and the lobby representing the unskilled is defensive*

Proof. See Appendix A2. ■

If, for example, τ_t^{su} is negative, this means that an increase in the lobbying activities by the lobby group representing the skilled will make the lobby group of the unskilled marginally less successful. The best response of the lobby group representing the unskilled to increasing political activity by the other group is, therefore, to invest less in rent seeking. It becomes clear that the unique Nash equilibrium is stable if (see Appendix *A*3)

$$\frac{\tau_t^{su}l_t^s - \tau_t^u}{2\tau_t^s - l_t^s\tau_t^{ss}} < -\frac{\tau_t^{uu}l_t^s}{\tau_t^{su}l_t^s - \tau_t^u} \tag{4.17}$$

The above condition shows that the absolute value of the slope of the best response functions of the skilled should be smaller than the absolute value of the slope of the

reaction function of the unskilled. The following subsection discusses the effects of a change in wage of the skilled to illustrate the working of the political model.

An increase in the wage of skilled workers

In this subsection we illustrate the working of the lobby model by analyzing the effects of an increase in inequality that results from a change in technology that increases the productivity of skilled workers (relative to the productivity of unskilled), i.e. an increase in A^s.

Assume that initially, at $t = 0$, the economy is in the steady state and an unanticipated increase in A^s occurs. Note that the number of skilled and unskilled is predetermined and thus will not change initially. The immediate effect of an increase in A^s is reflected in a higher gross wage of skilled workers w^s, leading to an increase in the wage gap between skilled and unskilled workers. As can be seen from the first-order condition (4.16), an increase in the wage gap incites unskilled to lobby more. This is due to the increase in the tax base automatically implying an increase in the rent the unskilled can obtain, while the costs of lobbying do not change. This so-called *cost-benefit effect* will - *ceteris paribus* - have a positive effect on the tax rate. However, the skilled will react to the increase in the rent seeking activity of the unskilled. The effect on the lobby effort of the skilled depends on the character of the lobby group. If $\tau_t^{su} > \tau_t^u > 0$, the lobby group representing the skilled is defensive and will react to the increased political activity of the unskilled by reducing its lobby effort. This is illustrated in Figure 1A.

The wage increase for the skilled workers implies a parallel shift rightward of the best response function of the lobby group representing unskilled workers. Consequently, the political equilibrium moves from E_0 to E_1 and the tax rate will unambiguously rise. It is evident that the unskilled's welfare will increase due to positive technological shock as they will receive a higher benefit, for any given level of lobbying activity, that is, the extra time lost in lobbying will be offset by a generous redistributive policy. The effect on the welfare of the skilled is ambiguous: the wage increase as well as the decrease in lobbying have a positive effect on utility,

but this may be offset by an increase in the tax rate if the extra lobby efforts of the unskilled are very successful. If the lobby group of the skilled is offensive (i.e. $\tau_t^{su} < 0$ or $\tau_t^u > \tau_t^{su} > 0$) (see Figure 1B) the skilled react to the increased lobby effort of the unskilled by raising their activity in the political arena.

Figure 1A : A sketch of the reaction of the political system with $0 < \tau^u < l^s\tau^{su}$

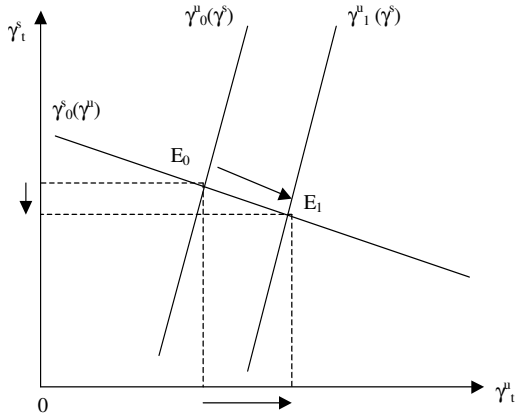
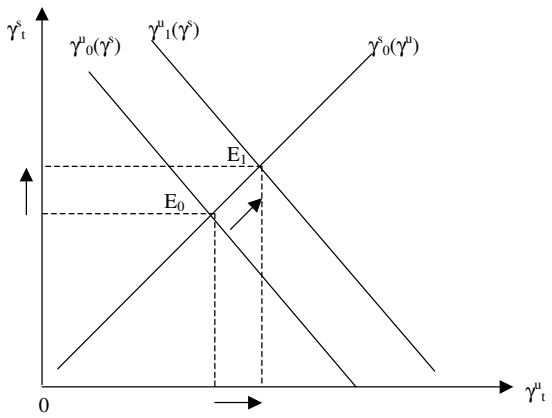


Figure 1B. Effects of an increase in wage gap with $\tau^{su} < 0$ or $\tau^u_t > \tau^{su}_t > 0$.



As a result more resources are lost in the political struggle, but the effect on the tax rate is ambiguous. For the increase in the rent seeking activities of the unskilled to dominate the increase in the lobbying effort of the skilled, and thus for the tax rate and the welfare of the unskilled to rise, it is required that

$$\frac{\tau_t^{su} l_t^s - \tau_t^u}{2\tau_t^s - l_t^s \tau_t^{ss}} < 1 \tag{4.18}$$

The effect on the utility of the skilled will be ambiguous again: the wage increase will positively affect their welfare, but the extra time lost in lobbying as well as the increase in the tax rate will have a negative effect.

So far, we only looked at the effects of the increase in productivity of the skilled in the first period and thus on the welfare of the current generation of skilled and unskilled workers. However, it is evident that such a shock will have effects on the welfare of future generations also. First, there is a direct effect on the inheritance of the children of the current workers: assuming that the increased rent seeking activities by the unskilled do not completely offset the welfare gain for the skilled

due to the higher wage, all bequests will be higher. This may enable some children of unskilled parents to afford education and thus raise their lifetime income by more than just the increased inheritance. Second, the increase in the number of skilled that results if more children can afford education, will change the political equilibrium and lead to a lower tax rate. Third, a change in the number of skilled may affect the technological spill overs and thus influence economic growth. Finally, these effects are of course not restricted to the first period, but will propagate themselves to the following periods, leading to a gradual transition to a new steady growth path. In the subsequent sections, these dynamic effects are studied. In particular, Section 4.3 discusses the dynamics of wealth and redistribution, i.e. the first and the second effect. Section 4.4 elaborates on the relation between the number of (un)skilled and the growth rate. Assuming a simple specification for the tax function (4.13), this section also derives the long-run relation between the tax and the growth rate. It is shown that this relation is typically non-monotonic. In Section 4.5 we present the results of some numerical simulation experiments illustrating the adjustment process towards a new steady growth path.

4.3 Dynamics of Wealth and Redistribution

As already noted, individuals who inherit an amount larger than h_t are able (and willing) to invest in human capital and become skilled in the second period of their life. Consequently, the distribution of inheritances in period t determines the number of skilled in period $t+1$. Let D_t be this distribution: $\int_0^\infty dD_t(b_t) = N$, then the number of skilled in the next period is:

$$N_{t+1}^s = \int_h^\infty dD_t(b_t) \tag{4.19}$$

and the number of unskilled:

$$N_{t+1}^u = \int_0^h dD_t(b_t) \tag{4.20}$$

The distribution of wealth at time t not only determines the numbers of skilled and unskilled in period $t+1$, but also affects redistribution, technological spill overs

and growth in both sectors, and thus indirectly the distribution of inheritances in future periods. These dynamic effects are quite complex. In this section we neglect the effects on technology and growth (i.e. we assume $\theta^s = \theta^u = 0$ so that w^u, w^s and h are constant) and discuss the dynamic relation between redistribution and wealth. These dynamics can be described by

$$b_{t+1} = (1-\alpha)(1+r)\, b_t + q_t \tag{4.21}$$

where q_t is

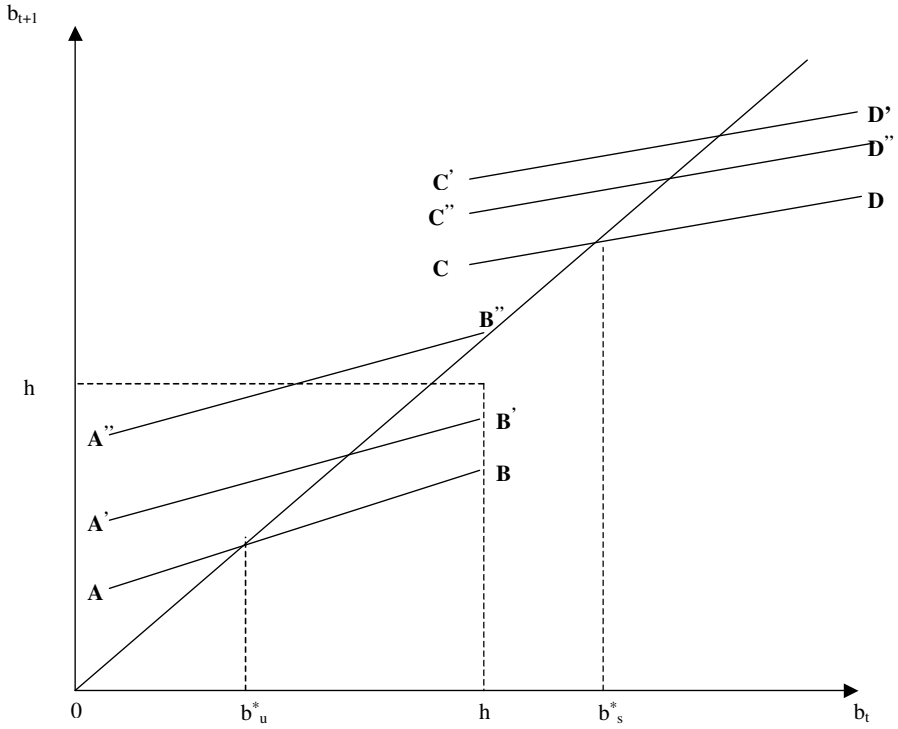
$$q_t = \begin{cases} (1-\alpha)\left[l_t^u w^u + \lambda_t\right] \equiv q_t^u \text{ if } b_t < h \\ (1-\alpha)\left[(1-\tau_t)\, l_t^s w^s - (1+r)\, h\right] \equiv q_t^s \text{ if } b_t \geq h \end{cases} \tag{4.22}$$

We assume that the dynamic equation is stable,

$$(1-\alpha)(1+r) < 1$$

Moreover, we assume that initially $q_t^u < [1-(1-\alpha)(1+r)]h$ and $q_t^s < [1-(1-\alpha)(1+r)]h$. That is, we assume that polarization prevails and children of unskilled parents will be unskilled and children of skilled parents will become skilled. This case is illustrated by the lines AB and CD in Figure 2.

Figure 2. Dynamics of Wealth Distribution



In this case, the number of skilled and unskilled is constant, and hence (given that the wages are also assumed to be constant) the tax rate and q^u and q^s will be constant. As a result, equation (4.22) is a piecewise linear function that intersects the 45^o-line two times, at the equilibria, $b_u^* \equiv \frac{q^u}{1-(1-\alpha)(1+r)}$ and $b_s^* \equiv \frac{q^s}{1-(1-\alpha)(1+r)}$. So, in the long run, wealth levels within the groups converge, but there is complete dichotomy between the two groups. The long-run level of average wealth can be expressed as $\bar{b} = b_u^* + \frac{N^s}{N}\left(b_s^* - b_u^*\right)$,which is increasing with $\frac{N^s}{N}$ if b_u^* and b_s^* are taken to be constant. However, a change in the number of skilled will shift the political equilibrium and thus affect b_u^* and b_s^*. In particular, an increase in the number of skilled will decrease the tax rate, and lower b_u^* and raise b_s^*. So the relation between redistribution and average wealth is not straightforward.

In order to further investigate the relation between redistribution and wealth, the next subsection presents the dynamic effects of an increase in the wage of the skilled.

An increase in the wage of the skilled workers

The analysis starts from the initial situation as illustrated by the lines AB and CD in Figure 2. We analyze the effect of a once-and-for-all increase in w^s.[9] As discussed in subsection 4.2.3, this affects lobbying and thus redistribution, but the exact effects depend on the form of the tax function. The analysis in this subsection is based on the assumption that the tax rate and the net income of both the skilled and the unskilled rises.

The increase in w^s raises q^s. This results in an upward shift of the line CD in Figure 2 to C'D'. The subsequent increase in redistribution raises q^u and lowers q^s, but we assume that q^s will still be larger than in the initial situation. So C'D' shifts down to C"D" and AB shifts up. Now there are two possibilities: the increase in q^u may or may not be large enough to allow the children of the unskilled with the highest inheritance to become skilled. In the latter case, AB shifts up to A'B', but the number of skilled does not change and the lines in the figure do not shift anymore. In the former case, however, the dynamic process is much more complicated. In this case AB shifts up further, for example to A"B". As a consequence, children with an inheritance just below h will be able to afford investing in human capital and consequently, in the next period the number of skilled will be higher. This shifts the political equilibrium. In particular, the unskilled will lobby more as the higher number of skilled implies a larger tax base and thus an increase in the marginal benefit from lobbying for a higher tax rate while the marginal costs of lobbying will not change. This *dependency ratio effect*[10] will have an upward effect on the tax rate. At the same time however, the lobby of the skilled will gain influence relative to that of the unskilled because of the increase in their relative number. This *group size effect* will - *ceteris paribus* - lower the tax rate. We assume the dynamic process to be stable, i.e. it assumed that the group size effect dominates the dependency ratio effect so that the tax

[9] To be more precise, we analyze the effects of an increase in the productivity of skilled labour A^s that is assumed to be constant here. We do not raise h, however, so the increase in A^s goes along with a decrease in γ^s.

[10] In fact, the *dependency ratio effect* is a special case of what we labelled the *cost-benefit effect.*

rate will fall again. This will in the next period shift A"B" downward again while C"D" shifts up again. Once more, there are two possibilities: either the number of skilled remains constant from then on and curves do not shift anymore, or the number of skilled rises further and the process goes on shifting AB future down and CD further up. This continues until AB is so far down that a new equilibrium is reached where the number of skilled does not rise anymore. In this new equilibrium, the number of skilled will be larger than in the initial situation, and the number of unskilled will therefore be lower. Moreover, redistribution and the amount of time both groups spend on political activities will have changed.

Note that in this subsection, we abstracted from technological spill-overs and growth. However, is evident that if we take growth into account, the growth rate in the new steady state will be different from the initial growth rate. It is not evident what the exact effect on growth is, however. Therefore, in the next section, we analyze the relation between redistribution, the size of both sectors and long-run growth.

4.4 Redistribution, Spill-overs, and Growth in the Long Run

The aim of this section is to illustrate the relation between redistribution, technological spill-overs, and economic growth. We first analyze the relation between the long-run growth rate and the number of skilled and unskilled, for given amounts of time spend on lobbying by both groups. Subsequently, we assume a specific functional form of the tax influence function and analyze the relation between growth and the tax rate.

Increasing the number of skilled *ceteris paribus* increases skilled production which, due to spill-over effects, leads to higher growth rates in both sectors. However, given total population size, an increase in the number of skilled implies a decrease in the number of unskilled which exerts downward pressure on the growth rates in both sectors. As a result, an increase in the number of skilled only increases

growth if the number of unskilled is relatively large, i.e. if the number of skilled is below its optimal level. This is summarized in the following proposition.

Proposition 4.1 *An increase in the number of skilled leads to higher long-run growth if and only if* $N^s < \left(\frac{\pi}{1+\pi-\phi}\right) N$.

Proof. See Appendix B1 . ■

This proposition assumes the amount of time individuals spend on lobbying to be constant. However, we know from the political model that, in general, changes in the size of both lobby groups affect lobby efforts. Consequently, given wages of skilled and unskilled, there is a relation between group size and the tax rate. In order to be able to analyze this relation, we simplify the model by introducing a specific functional form for the tax influence function (4.13). We assume this function to be of the following form:

$$\tau_t = \tau_o \left(\frac{N_t^u}{N_t^s}\right)^{\mu} \left(\frac{\gamma_t^u}{\gamma_t^s}\right)^{\rho}, \mu > 0, \rho < 1, \tag{4.23}$$

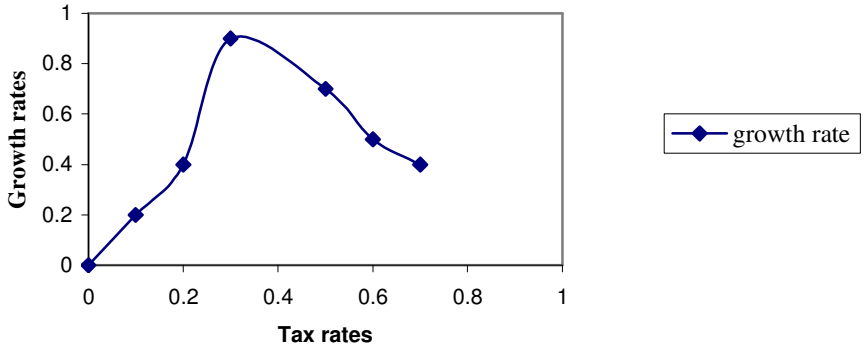
Note that this function satisfies the condition with respect to the first- and second order derivatives and that the cross derivative $\tau^{su} < 0$. The latter implies that the lobby group representing the unskilled is defensive while the group representing the skilled is offensive. Using this function and the corresponding first-order conditions to substitute out γ_t^u and γ_t^s, we can specify the relation between group size and the tax rate. Combining this with the relation between group size and long-run growth as summarized in Proposition 1, we are able to derive a relation between the tax rate and long-run growth rate, i.e. a relation between redistribution and growth as shown in the following equation (see Appendix B2 for details).[11]

$$g = \Theta \tau^{\left(\frac{\phi-1}{\rho-u(1+\pi-\phi)}\right)} (1-\tau)^{\left(\frac{\rho(\phi-1)}{\rho-u(1+\pi-\phi)}\right)} \tag{4.24}$$

[11] It should be noted that both the tax rate and the rate of growth are endogenous variables. The relation between these two variables results from comparing steady states with different number of skilled.

This relation is depicted in Figure 3.[12]

Figure 3. Non-monotonic relationship between growth and tax rate.



This figure illustrates what is already evident from equation (4.24): the relation between long-run growth and the tax rate is typically non-monotonic. This is the result of the interplay between several effects. First the political process plays an essential role. An increase in τ increases redistribution which enables some children of unskilled to join the pool of skilled. This raises the benefit of lobbying for the unskilled, and thus leads to additional political pressure to further increase the tax rate. However, via the group-size effect the higher number of skilled individuals will also lead to a stronger lobby to lower the tax rate. Moreover, an increase in τ distorts the labour-supply decision and leads to a reduction in effective labour supply - and thus an increase in lobbying activity - by the skilled. In a long-run equilibrium, the tax rate is stable, which is only possible if the political forces to increase and to decrease redistribution exactly balance. Second, the process of knowledge creation is important. Given the level of the wage of skilled workers relative to that of unskilled, the requirement that the political forces should exactly

[12]It should be noted that, for analytical convenience, equation (4.24) was derived using the relation between the number of skilled and the tax rate that underlies on Proposition 1. Consequently, the amount of time spend on lobbying is still not fully endogenized. However, numerical simulation experiments show that the relation between the tax rate and long-run growth is non-monotonic when political activity is fully endogenous (see Appendix C1 and Figure 6).

balance implies a certain size of both groups and an allocation time, and thus a certain level of production of skilled workers relative to that of unskilled. But, given that the growth rates of skilled and unskilled wages are equal in a steady state, this in turn determines relative wages (See equation 4.3). Of course, in order to have a long-run equilibrium, these relative wages should be consistent with the ones we assumed in the political process. This requirement results in a unique relation between the tax rate on the one hand and relative wages, group size and allocation of time on the other. This implies a relation between the tax rate and the level of production of skilled workers relative to that of unskilled: low tax rates go along with a relatively large production by skilled workers, high tax rates with relative low production of skilled. Differences in relative production go along with differences in the growth rate. As already suggested by Proposition 4.1, there is an optimum for the relative production by skilled workers and thus an optimum tax rate. As long as the tax rate is below this growth-maximizing level, raising the tax rate increases growth, above this level a higher tax rate leads to lower growth. The following proposition summarizes.

Proposition 4.2 *A non-monotonic relationship prevails between long-run growth and tax rate: for low values of the tax rate more redistribution goes along with higher growth, for high tax rates a further increase of redistribution goes along with lower growth.*

4.5 The Dynamics of Wealth, Redistribution and Growth

When the economy is not in the steady state, it converges via an adjustment process towards an equilibrium. During this adjustment process, wages of skilled and unskilled will grow at different rates. This adds additional effects to the relations discussed so far. In this next section, we illustrate the full dynamic adjustment process by numerical simulation experiments. As already noted, the adjustment process as well as the steady state depends on the initial wealth distribution. The

basic simulation experiment starts from a uniform distribution of wealth. We present two variants on this basic simulation. First, we illustrate the effect of the initial wealth distribution on the outcome of the dynamic process. Second, we discuss the full dynamic effects of a technological shock that increases the wage of the skilled. This complements the discussion of the partial effects of this shock in Sections 4.2 and 4.3.

4.5.1 The effect of the initial wealth distribution

Figures 4A-D present the results of the basic simulation and the effect of a change in the initial wealth distribution.

INSERT FIGURES 4A-D

The parameters for the basic simulation can be found in Appendix C1. This basic simulation starts with 100 individuals with wealth levels uniformly distributed on the interval $[1, 100]$. The starting level of the investment in human capital h is 60, and in the subsequent periods h is assumed to grow at the same growth rate as the wage of the skilled. Given the initial value of h and the distribution of wealth, the initial number of unskilled is 60. However, given the initial wage levels and the tax rate that initially results from the political process, some children of the initial generation of unskilled will be able to afford education and hence the number of unskilled drops to 56. This reduces the political influence of the unskilled and hence the tax rate is lower in the second period (despite the fact that the gap between the wages of the skilled and the unskilled has increased a bit due to the growth rate of skilled wages being higher than that of unskilled wages). This development continues with decreasing intensity in periods 3 and 4. By then the number of unskilled has decreased to 53 and the tax rate is more than 2 percent below its initial value. From then onwards, no children of unskilled are able to pass the threshold h and there is a complete dichotomy between skilled and unskilled. As a result, the decrease in the tax rate that results from the growth in size of the lobby group of the skilled stops. From then on, the tax rate even slightly increases again.

The reason for this is that the growth rate of the wage of the skilled is still larger than the growth rate of the wage of the unskilled, implying a growing wage gap and increasing investment in political activity by the unskilled. Due to spillover effects, the difference in the growth rate of wages of skilled and unskilled decreases over time and eventually the wage gap stabilizes and the economy reaches a steady state.

To illustrate the effect of a change in the initial distribution of wealth, we ran the same simulation starting from a flatter wealth distribution. That is, we took away 80 percent of the wealth above 75 and redistributed this wealth to the individuals with wealth below 75, in such a way that a continuous but kinked distribution results.[13] The redistribution of initial wealth enables one additional child to invest in human capital, leading to a lower number of unskilled in period one. The adjustment process that follows is qualitatively comparable to the one described above. However, the number of skilled will permanently be larger than in the simulation that starts from a uniform distribution of wealth, so the economy stabilizes in another steady state. In particular, the steady state that is reached starting from a flatter distribution is characterized by a larger wage gap, a lower tax rate and higher growth rate. This numerical example shows that, if the number of skilled is inefficiently low due to imperfect capital markets, redistribution of wealth may decrease inefficiency and foster growth. At the same time, however, this reinforces the political influence of the skilled and leads to more inequality and less redistribution in the long run. Still, due to the higher growth rate, also future generations of unskilled will be better off.

4.5.2 An increase in the wage of the skilled

Figures 5A-D present the results of the adjustment process if we start from an initial situation with a higher wage for the skilled as compared to the results of the

[13] The resulting distribution is: $b(i) = 75 + \frac{0.2*13}{37}(i - 75)$ for $i = 1, ..., 75$
$b(i) = 75 + 0.2(i - 75)$ for $i = 76, ..., 100$.

basic simulation.[14]

INSERT FIGURES 5A-D

The higher wage of the skilled will not affect the initial number of unskilled. However, the increased wage gap makes them lobby more. The skilled react to this by also slightly increasing their investment in political activity, but this is not sufficient to prevent a higher tax rate in the first period. The adjustment process is again similar to the one described above. However, the increased redistribution enables more unskilled to become skilled in the course of time. So, in the steady state, the number of skilled is higher. As a result, the tax rate is lower and growth is higher in the long run than in the simulation starting with a lower w^s. So, if the investment in human capital is inefficiently low due to capital market constraints, a technological shock that initially only benefits the skilled will eventually benefit all individuals. Via the political redistribution process, the unskilled will appropriate part of the gains which allows more unskilled to become skilled and thus fosters growth.

4.6 Concluding Remarks

We have analyzed the consequences of endogenous political decision making on redistribution in a two-sector endogenous growth model where growth is driven by human capital, investment in human capital is indivisible and capital markets are missing. In such an economy, investment in human capital tends to be inefficiently low and redistribution may have significant effects on growth.

The political-economy model used does not assume ex ante asymmetry in political influence[15], but the outcome may be asymmetrical due to differences in time invested in lobbying. These differences may be the result of *cost-benefit effects*, i.e. differences in the balance between the costs and benefits of lobbying. If technologi-

[14] That is, we start from a higher value of A_0^s, but h_0 is not increased.

[15] That is, abstracting from group-size effects, the possibilities to affect the outcome of the political process may be the same for skilled and unskilled individuals.

cal progress increases the wage gap between skilled and unskilled, for example, this will result in more active political support for social assistance, minimum wage laws and other types of intra-generational redistribution. On the other hand, when the political activity of unskilled workers increases, the dynamics of redistribution may cause the number of unskilled to shrink and the group of skilled workers to grow. If *group size effects* are important, that is, if the relative size of a lobby group matters for influencing government policy decisions, this may lead to a countervailing power of the skilled lobby for their sheer number. As a result of these two opposing forces persistence in inequality may prevail when redistribution is blocked, leading to multiple steady-state equilibria.

We have shown that the equilibrium that is actually realized in the long run is dependent upon the initial distribution of wealth. In particular, we have illustrated that effective redistribution of wealth can promote growth.

As another example, we analyzed the effects of a technological shock, which increases the wage gap between skilled and unskilled workers. This example illustrated that political decision making may be crucial for the effects of economic shocks. In particular, we demonstrated that if the unskilled via the political redistribution process, manage to appropriate part of the gains of such technological shock, this may enable some of them to invest in human capital and thus foster growth.

In the examples we presented, higher long-run growth is accompanied by a lower tax rate, i.e. less redistribution. This is not necessarily the case, however. We have shown that the relation between redistribution and long-run growth is non-monotonic: for low values of the tax rate, more redistribution can go along with higher growth, but for higher values of the tax rate the relationship is opposite. Moreover, due to the evolution of the opposing forces in the political process, the time path of the tax rate towards its steady-state level may be non-monotonic.

The analysis presented in this chapter allows for many useful extensions. For example, we did not take into account the accumulation of physical capital. This may overestimate the benefit that the unskilled derive from redistributive taxation as the income tax may reduce the pace of physical capital accumulation. Another

useful extension of the model could be to allow for nonlinear redistributive schemes and progressivity in income tax rates. However, the most promising route for further research seems to be further elaboration of the model of the political process. In particular, in our model, the effective pressure of a lobby group only depends upon its size and its political activity, and not on the economic position of its members. In reality, money also seems to play a role in influencing government decision making. Therefore, it would be interesting to see whether our results change if we allow for investment of wealth in addition to the investment of time in order to influence political decision making on redistribution.

Appendix to Chapter 4

Appendix A1: Growth rates are equal in the steady states.

If there exist steady state, the growth rate of skilled (g_t^s) and unskilled (g_t^u) sectors should be the same in the long run. To see this, re-writing (5.2) results:

$$\begin{cases} g_s = \frac{\Delta A_t^s}{A_t^s} = \theta^s S_t \left(\frac{S_t}{U_t}\right)^{\phi-1} \left(\frac{A_t^s}{A_t^u}\right)^{\phi-1} \\ g_u = \frac{\Delta A_t^u}{A_t^u} = \theta^u U_t \left(\frac{S_t}{U_t}\right)^{\pi} \left(\frac{A_t^s}{A_t^u}\right)^{\pi} \end{cases} \tag{A1}$$

For given steady state values of θ^s, θ^u, S and U, differentiating A1 with respect to time yields:

$$\begin{aligned} \frac{d}{dt}g_s &= (\phi-1)\,\Psi \left(\frac{A_t^s}{A_t^u}\right)^{\phi-2} \left(\frac{\frac{dA_t^s}{dt}A_t^u - \frac{dA_t^u}{dt}A_t^s}{\left[A_t^u\right]^2}\right) \\ \frac{d}{dt}g_u &= \pi\Omega \left(\frac{A_t^s}{A_t^u}\right)^{\pi-1} \left(\frac{\frac{dA_t^s}{dt}A_t^u - \frac{dA_t^u}{dt}A_t^s}{\left[A_t^u\right]^2}\right) \end{aligned} \tag{A2}$$

where Ψ and Ω are constants representing $\theta^s S \left(\frac{S}{U}\right)^{\phi-1}$ and $\theta^u U \left(\frac{S}{U}\right)^{\pi}$ parameters respectively. Substituting A1 into A2 and rewriting A2 results:

$$\frac{d}{dt}g_s = (\phi-1)\,g_s(g_s - g_u) \tag{A3}$$

$$\frac{d}{dt}g_u = \pi g_u(g_s - g_u) \tag{A4}$$

If $g_u > g_s$, from A3 it implies that as time proceeds g_s is continuously increasing i.e. $\lim_{t\to\infty} g_t^s > 0$. But in the steady state g_s must be constant and so this is a contradiction to the definition of steady state value. Similarly, if $g_s > g_u$ it implies that $\frac{A_t^s}{A_t^u}$ should continuously increase i.e. $\lim_{t\to\infty} g_t^u > 0$ is growing with out limit. So it is not steady state growth. Therefore, $\lim_{t\to\infty} g_t^s = g_t^u = 0$ only when the growth rates in both sectors are equal i.e. $g_s = g_u$

Appendix A2: Proof of Lemma 1

It is straight forward to derive the best response functions for both lobby groups. After differentiation of first-order condition (4.15) one gets,

$$-\tau_t^{su} l_t^s d\gamma_t^u - l_t^s \tau_t^{ss} d\gamma_t^s + \tau_t^s d\gamma_t^s = -\tau_t^u d\gamma_t^u - \tau_t^s d\gamma_t^s \tag{A5}$$

Rearranging, gives the slope of the reaction function for the skilled

$$d\gamma_t^s = \frac{\tau_t^{su} l_t^s - \tau_t^u}{2\tau_t^s - \tau_t^{ss} l_t^s} d\gamma_t^u \tag{A6}$$

As noted from (4.14) , since $(\tau_t^s < 0, \tau_t^{ss} > 0, \tau_t^u > 0)$ the slope of the reaction curves is determined by the sign of τ_t^{su} and also the size of τ_t^u and τ_t^{su}. If $\tau_t^{su} > \tau_t^u > 0$ holds, then the slope will be negative. However, if $\tau_t^{su} < 0$ or $\tau_t^u > \tau_t^{su} > 0$ holds, then the slope of the reaction function of the lobby group representing the skilled will be positive and hence the lobby group is offensive.

For the lobby group representing unskilled, totally differentiating (4.16) gives

$$\frac{N_t^s}{N_t^u} w_t^s l_t^s \tau_t^{uu} d\gamma_t^u + \frac{N_t^s}{N_t^u} w_t^s l_t^s \tau_t^{su} d\gamma_t^s - \frac{N_t^s}{N_t^u} \tau_t^u w_t^s d\gamma_t^s + \frac{N_t^s}{N_t^u} \tau_t^u l_t^s = 0 \tag{A7}$$

Re-arranging and eliminating terms, the following equation gives reaction function for the unskilled

$$d\gamma_t^u = -\frac{\tau_t^{su} l_t^s - \tau_t^u}{\tau_t^{uu} l_t^s} d\gamma_t^s - \frac{\tau_t^u}{w_t^s \tau_t^{uu}} \tag{A8}$$

Given that $\tau_t^{uu} < 0$, it is straight forward to derive the sign of best response function of the unskilled. If $\tau_t^{su} > \tau_t^u > 0$ holds, then the slope will is positive and hence the lobby group is offensive. However if $\tau_t^{su} < 0$ or $\tau_t^u > \tau_t^{su} > 0$, the slope will be negative and hence the lobby group will be defensive. This proves Lemma 1.

Appendix A3: Proof of the Stability Condition

In this appendix we proof the stability condition (4.17). If the pressure of u and s deviate in period t from their equilibrium levels by the small amounts $d\gamma_t^s$ and $d\gamma_t^u$, then the optimizing conditions for skilled and unskilled is given by equations (4.15) imply that

$$\begin{cases} \left(2\tau_t^s - \tau_t^{ss} l_t^s\right) d\gamma_t^s - \left(\tau_t^{su} l_t^s - \tau_t^u\right) d\gamma_{t-1}^u = 0 \\ \left(\tau_t^{su} l_t^s - \tau_t^u\right) d\gamma_{t-1}^s + \left(\tau_t^{uu} l_t^s\right) d\gamma_{t-1}^u = \tau_t^u l_t^s \end{cases} \tag{A9}$$

Hence by substitution

$$d\gamma_t^s = \left[\frac{(\tau_t^{su} l_t^s - \tau_t^u)}{(2\tau_t^s - \tau_t^{ss} l_t^s)}\right]\left[\frac{-(\tau_t^{su} l_t^s - \tau_t^u)}{(\tau_t^{uu} l_t^s)}\right] d\gamma_{t-1}^s + \left[\frac{\tau_t^{su} l_t^s - \tau_t^u}{2\tau_t^s - \tau_t^{ss} l_t^s}\right]\frac{\tau_t^u l_t^s}{w_t^s} \tag{A10}$$

which implies that $d\gamma_{t+1}^s$ and $d\gamma_{t+1}^u$ return to their equilibrium values if the absolute value of the determinant is positive i.e.

$$|A| = \left(-\left(2\tau_t^s - \tau_t^{ss} l_t^s\right)\left(\tau_t^{uu} l_t^s\right) - \left(\tau_t^{su} l_t^s - \tau_t^u\right)^2\right) > 0 \tag{A11}$$

This proves the stability condition in (5.17) .

Appendix B1: Proof of Proposition 4.1

From equation (4.4) we have that

$$g_A = \theta^s S \left(\frac{\theta^s}{\theta^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{S}{U}\right)^{\frac{\phi-1}{1+\pi-\phi}} \tag{B1}$$

Rewriting the above equation and letting $\delta = \frac{\pi}{1+\pi-\phi}$ and $1-\delta = \frac{1-\phi}{1+\pi-\phi}$ we find

$$g_A = \theta^s \left(\frac{\theta^s}{\theta^u}\right)^{\delta-1} \left(N^s l^s\right)^{\delta} \left(\left(N - N^s\right) l^u\right)^{1-\delta} \tag{B2}$$

The effect of an increase in the supply of skilled people N^s. on growth is determined by partially differentiating the above function w.r.t N^s and applying the product rule, which gives

$$\frac{\partial g_A}{\partial N^s} = \left[\theta^s \left(\frac{\theta^s}{\theta^u}\right)^{\delta-1}\right]\left[\frac{N^s l^s}{\left(N - N^s\right) l^u}\right]^{\delta} l^u \left[\delta\frac{(N - N^s)}{N^s} - (1-\delta)\right] \tag{B3}$$

The sign of $\frac{\partial g_A}{\partial N^s}$ is positive if and only if $\left(\frac{\pi}{1+\pi-\phi}\right) N > N^s$. This proves Proposition 4.1.

Appendix B2: Proof of Proposition 4.2

The tax influence function as specified in equation (5.23) has the following characteristics:

$$\begin{aligned}
\tau^u &= \rho\frac{\tau}{\gamma_{t+1}^u} > 0, \tau^s = -\rho\frac{\tau}{\gamma_{t+1}^s} < 0 \\
\tau^{uu} &= \rho(\rho-1)\frac{\tau}{\left(\gamma_{t+1}^u\right)^2} < 0, \tau^{ss} = \rho(\rho+1)\frac{\tau}{\left(\gamma_{t+1}^s\right)^2} > 0, \\
\tau^{su} &= \tau^{us} = -\rho^2\tau/(\gamma_{t+1}^u\gamma_{t+1}^s) < 0
\end{aligned} \tag{B4}$$

From the first-order conditions (4.15) and (4.16) we have that

$$\frac{\tau_t^u}{\tau_t^s} = -\frac{N_t^u w_t^s}{N_t^s w_t^u \left(1-\tau_t\right)} \tag{B5}$$

and consequently

$$\frac{\gamma_t^s}{\gamma_t^u} = \frac{N_t^u w_t^u}{N_t^s w_t^s \left(1-\tau_t\right)} \tag{B6}$$

Solving for γ^u and γ^s, we find

$$\gamma_t^u = \frac{\rho\tau_t}{1+\tau_t\left(\rho-1\right)}\frac{w_t^s}{w_t^u}\frac{N_t^s}{N_t^u} \tag{B7}$$

$$\gamma_t^s = \frac{\rho\tau_t}{1+\tau_t\left(\rho-1\right)} \tag{B8}$$

Using $(B6)$ to substitute out γ_t^u and γ_t^s from (4.23) gives

$$\frac{N_t^s}{N_t^u} = \left[\frac{\tau_t}{\tau_o\left(1-\tau_t\right)^\rho}\left(\frac{w_t^s}{w_t^u}\right)^{-\rho}\right]^{1/(\rho-\mu)} \tag{B9}$$

Inserting the wage gap equation (4.3) in the above equation and re-arranging we have that

$$\frac{N_t^s}{N_t^u} = \left[\left(\frac{\tau_t}{\tau_o\left(1-\tau_t\right)^\rho}\right)^{\frac{1+\pi-\phi}{\rho-\mu(1+\pi-\phi)}}\left(\frac{\theta^s}{\theta^u}\right)^{\frac{-\rho}{\rho-\mu(1+\pi-\phi)}}\left(\frac{l_t^s}{l_t^u}\right)^{\frac{\rho(\pi-\phi)}{\rho-\mu(1+\pi-\phi)}}\right] \tag{B10}$$

Substituting $(B10)$ into $(B2)$ and rearranging, we find

$$g_t = \Theta\tau_t^{\left(\frac{\phi-1}{\rho-u(1+\pi-\phi)}\right)}\left(1-\tau_t\right)^{\left(\frac{\rho(\phi-1)}{\rho-u(1+\pi-\phi)}\right)} \tag{B11}$$

where $\Theta = N_t^s\left(\frac{\theta^s}{\tau_o}\right)\left(\frac{\theta^s}{\theta^u}\right)^{\frac{-\mu(\phi-1)}{\rho-\mu(1+\pi-\phi)}}\left(l_t^s\right)^{\frac{\rho\phi-\mu\pi}{\rho-\mu(1+\pi-\phi)}}\left(l_t^u\right)^{-\left[\frac{(\phi-1)(\rho-\mu)}{\rho-\mu(1+\pi-\phi)}\right]}$. Loosely speaking, if Θ is taken to be constant equation $(B11)$ says that the relation between g and τ_t is non-monotonic. Θ can be fully endogenize if we eliminate l_t^s and l_t^u and express them in terms of γ_t^u and γ_t^s. That is, equations $(B7)-(B11)$ can be used to in combination with $N^u+N^s=N$ to solve for γ_t^u, γ_t^s, N^u, N^s, $\frac{w_t^s}{w_t^u}$ and g as a function of the tax rate. After some tedious algebra one can express the relation as

$$\begin{aligned} g_t \;=\; & N_t^s\theta^s\left(\frac{\theta^s}{\theta^u}\right)^{-(1-\alpha)}\left(\frac{A_s^0}{A_u^0}\right)^{\frac{p(1-\alpha)}{\rho-\mu}}\left(\frac{1-\tau}{1+\tau(\rho-1)}\right) \\ & \left(\frac{\left(1-\tau\right)\left(\tau_o\right)^{\frac{1}{\rho}}\left(N_t^u\right)^{\frac{\mu}{\rho}}}{\left(\left(1+\tau(\rho-1)\left(\tau_o\right)^{\frac{1}{\rho}}\left(N_t^u\right)^{\frac{\mu}{\rho}}\right)-\rho\left(\tau\right)^{\frac{1+\rho}{\rho}}\left(N_t^s\right)^{\frac{\mu}{\rho}}\right)}\right)\left(\frac{\tau}{\tau_o\left(1-\tau\right)^\rho}\right)^{\left(\frac{-(1-\alpha)}{\rho-\mu}\right)} \end{aligned} \tag{B12}$$

Unfortunately, the resulting expressions do not provide much insight. However, figures 3 and 6 summarize the behavior of growth and tax variables. That is a growth-maximizing tax rate exists and can be shown by setting $\frac{\partial g_t}{\partial \tau} = 0$ and checking $\frac{\partial^2 g_t}{\partial \tau^2} < 0$. Combining the tax influence function (4.23), the first-order conditions (4.15) and (4.16), and the expression for steady-state growth in equation $(B1)$, a relation between the tax rate and the long-run growth can be derived that takes full account of the endogeneity of lobbying. Simulation shows that this relation between redistribution and growth is non-monotonic. Figure 6 illustrates this relation.

Appendix C1: Numerical Simulation.

In this appendix, we provide some information on the numerical simulation examples we performed. The table 4.1. presents the parameter settings used in the experiments. The simulations are performed by Compaq Visual Fortran. The relevant program is available from the authors.

Table 4.1: Parameter Values

Parameter	Definition	Value
h_0	Initial cost of becoming skilled	60
A_0^u	Initial wage of unskilled workers	50
A_0^s	Initial wage of skilled workers	140
μ	Group size effect	1.20
ρ	Opportunity cost effect	0.10
α	Share of consumption	0.50
r	Interest rate	0.20
N	Total number of individuals	100
τ_0	Transfer base	0.05
θ_u	Shift parameter	0.0008
θ_s	Shift parameter	0.002
π	Effect of production on creation of knowledge of unskilled	0.35
ϕ	Effect of production on creation of knowledge of skilled	0.80

Figure 4A. Growth rates of skilled sector under different Distribution of Wealth

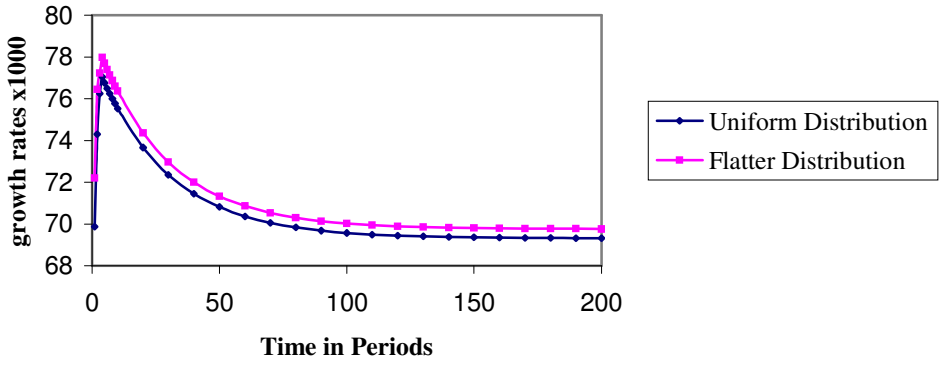


Figure 4B. Tax rates Under different Distributions of Wealth

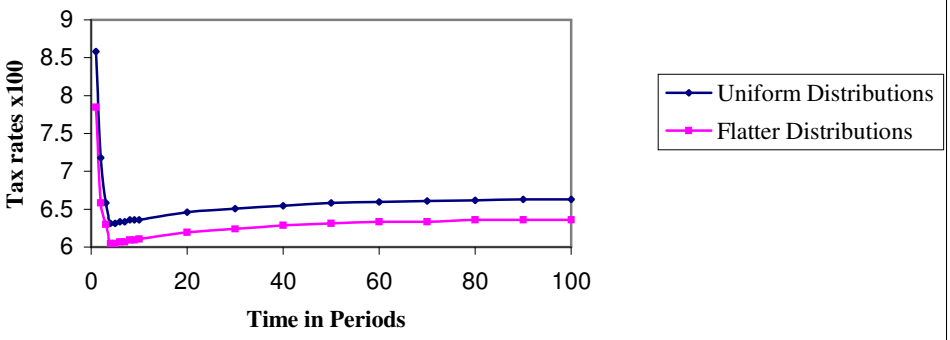


Figure 4C. Wage Gaps under different distributions of wealth

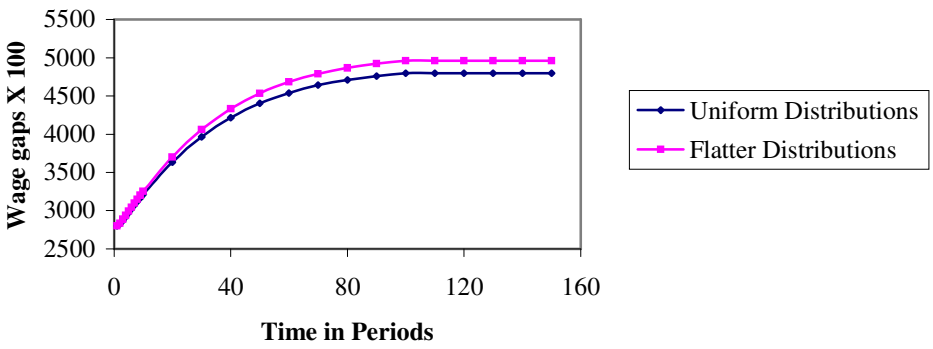


Figure 4D. Number of Unskilled individuals under different Distribution of Wealth

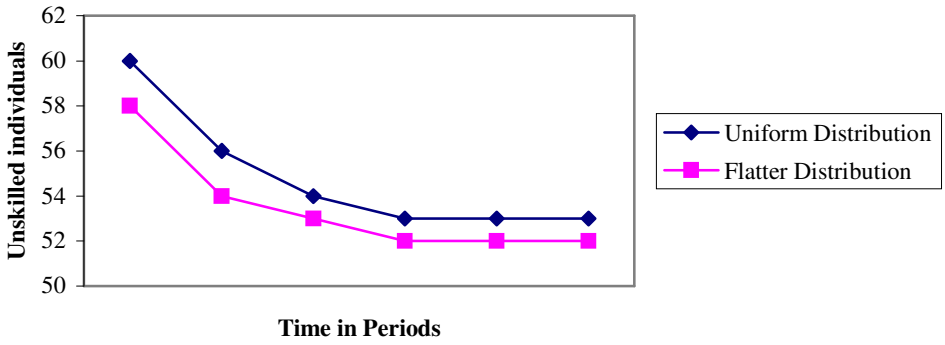


Figure 5A. Effect of wage increase on growth rates under uniform Distribution

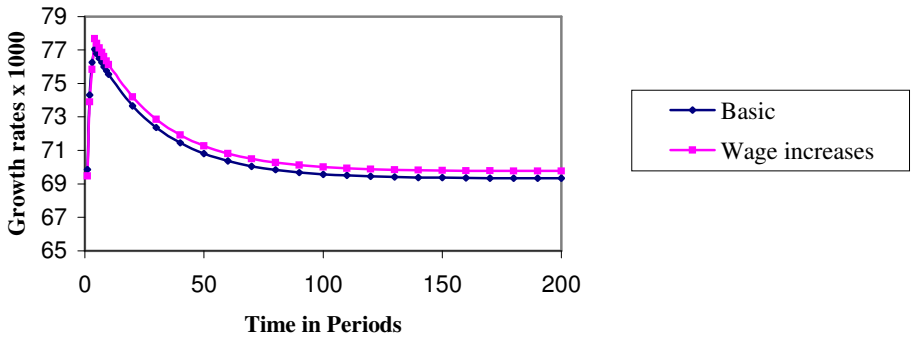


Figure 5B. Effect of wage increase on Tax Rates under Uniform Distribution of Wealth

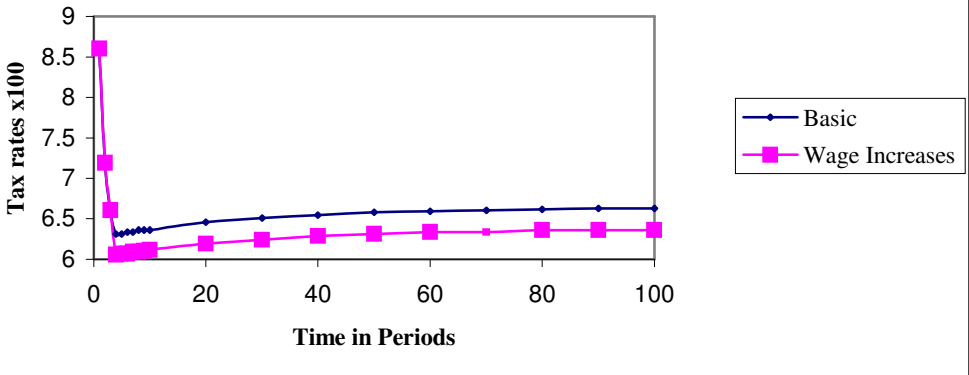


Figure 5C. Effect of wage increase on wage gaps under uniform distribution of wealth

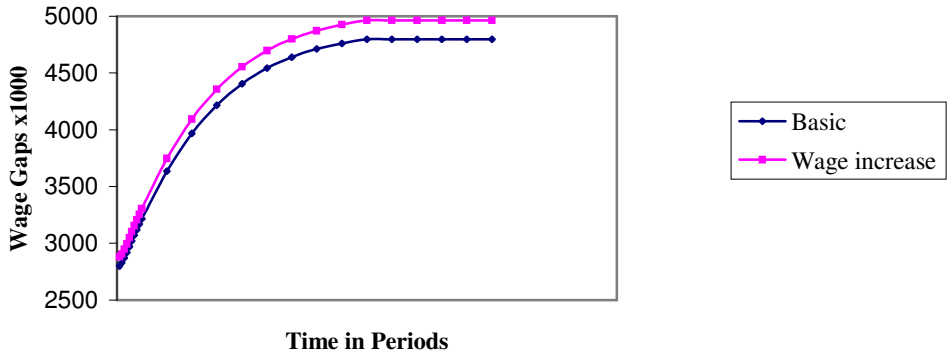


Figure 5D. The Effect of wage increase on the evolution of Long run # of unskilled individuals under uniform distribution

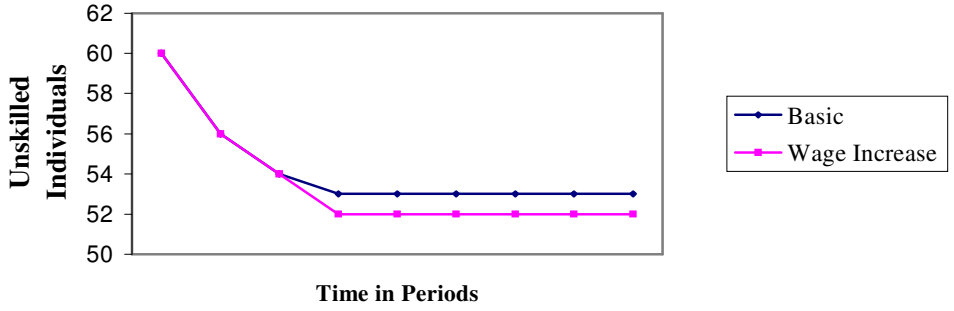
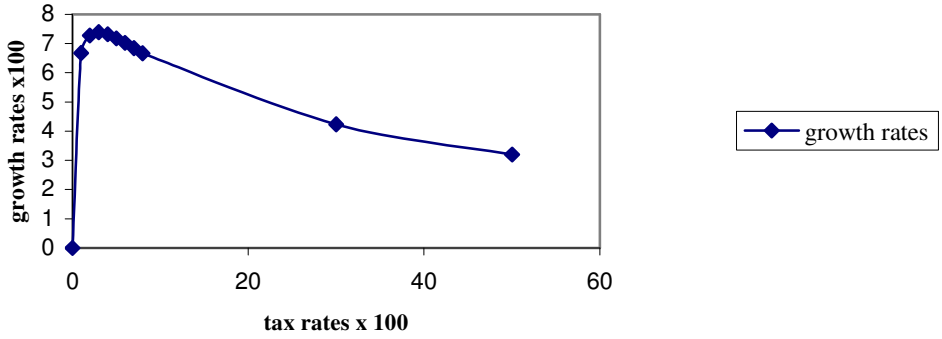


Figure 6. Non-monotonic relationship between growth and tax rate



Chapter 5

Inequality, Tax Exemptions and Economic Growth

5.1 Introduction

In an environment where the institutional setup reflects weak governance and bad tax administration, excessive tax evasion is observed. The link between inequality, corruption, and growth finds support in the numerous surveys in which business people voice their concern for corruption and preferential treatment (Lambsdorff, 2002). Some of the links between corruption and governments are straightforward. Taxes are diverted directly into the pockets of government officials. In 2001, for example, some $900 million, one tenth of the country's GDP, simply disappeared from Angola's treasury (The *Economist*, October 26, 2002). A second effect of corruption is that governments undertake policies solely to generate more opportunities for bribery. Third, corrupt government officials have a strong interest in ensuring that there is no strong judicial system to stand in their way. Corruption, being by definition illegal, is usually accompanied by wasteful spending resources in order to avoid detection. Finally, excessive spending in investment projects by the public sector, crowd out more efficiency-oriented private investment (Mauro, 1995).

Harberger (1998) argues that the role of taxation in income distribution has

been somewhat limited. He argues that countries and especially poorer countries, have rarely been able to tax wealth or property effectively. In the past years, when high marginal tax rates were imposed, they were often accompanied by many loopholes leading to horizontal inequalities i.e. taxpayers with similar incomes end up getting different preferential treatment suggesting that there is an incentive to offer a bribe to get exempted. The existence of corruption, however, is not only restricted to developing countries. Recent high level corruption scandals in, for example, France and Germany indicate that the OECD countries are not immune to this phenomenon. In the United States, the recent collapse of the major energy firm Enron has focused the attention on firms overt and hidden activities (See Graichen *et al.* (2001)).

In chapter 4, we demonstrate that technological progress that results in increased inequality could increase the welfare of unskilled individuals. However, in case of a wealth biased system, parts of the population could not grab the benefit of economic growth. Benefits that accrue to poor individuals could also be dampened by the lobbying activity of high-income groups and various imperfections inherent in the political process that determine the tax system. To explain this phenomenon, the model in chapter 4 is enriched by considering the possibility that very rich individuals pay contributions to the politicians in order to be exempted from paying taxes. This is motivated by the fact that pre-tax inequality may not always lead to a higher degree of redistribution. In effect, it might explain the failure of empirical studies to support a positive relationship between equality and redistribution.

We merge the two literatures of political economy models. We use a pressure group model of the Becker (1984) type, that assumes active participation of potential voters in the form of lobbying to influence policies.[1] Moreover, the model builds on the menu auction model originating with Berheim and Whinston (1986), which has been applied by Grossman and Helpman (1994) to trade policy, by Damania (2001) to environmental policy and by Rodriguez to political economy of taxation (2000). However, these papers typically neglect dynamic issues and focus on an

[1] Such activities are a common practice in democracies and often require real resources which would otherwise be utilized in direct production (see Rodriguez, 2000)

endogenous policy model with interest groups of a fixed size. According to Baron (2002) little is known about the dynamics of political choice and how interest group strategies might change in such a setting.

To the best of our knowledge, studies conducted to endogenize the weight the politician attaches to its constituents are very rare. This chapter does so by linking the political decisions to economic variables rather than only to political settings. More so, this chapter attempts to examine the dynamics of a policy choice since a policy choice by the politician requires to take into account the current period utility. Thus, the relative weight placed by government on aggregate social welfare and bribes is endogenous and time variant.[2] Not only does it explain why the relationship between redistribution and inequality is non-monotonic, but it also tries to contribute to the understanding of why some societies invest more in human capital than others.

In this model, politicians maximize political support by mixing popular policies with campaign spending. Campaign contributions are offered by individuals who are wealthy and therefore have greater incentives and opportunities to use bribery (both grand political corruption and bureaucratic corruption) and fraud to escape taxation.[3] The effective pressure of lobbying depends not only on the economic position of its members but also on the political activity. The unskilled are less likely to be exempt, as getting exemption demands financial contributions. They can be a politically active group, however, by investing time in political activities such as strikes, working on campaigns, writing to members of parliament, lockouts etcetera. In line with this, we assume that individuals who favour higher taxes invest time to influence the political outcome, i.e. the level of redistribution. The willingness of government politicians to deviate from optimal policy making here reflects the level of corruptibility.

On the economic side, we develop a two-sector endogenous growth model in

[2] Our model of the political process also includes a model of bribery, which serves as a guidance for our empirical work that we discuss in Chapter 7.

[3] In this paper we neglect the benefits of campaign spending, rather we focus on the drawback of fund raising i.e. funds raised for corruption and the like.

which growth is driven by human capital, and capital markets are missing. It is important to note that investment in human capital is indivisible, as in Galor and Zeira (1993), which in turn implies that in the long run there will be polarization of wealth between educated (rich) individuals and uneducated (poor) ones. In such an economy, investment in human capital tends to be inefficiently low and redistribution may have significant effects on growth. Given this political and economic venue, we ask whether the dynamic political process leads to growth enhancing redistribution. Hence, in our model, the distribution of income, human capital accumulation, the growth rate, the tax rate and the weight the social planner attaches to groups in society are simultaneously endogenous and are analyzed in a dynamic setting.

We conjecture that the actual tax revenue (effective tax rate) could be lower than the growth maximizing tax revenue as rich people evade paying taxes by bribing politicians. The potential tax revenue, which is positively related to human capital accumulation, will be blocked due to opposing forces leading to multiple steady state equilibria. Thus, our paper can be viewed in terms of its contribution as providing an explicit mechanism through which politics leads to inefficiency.

Our result supports the spreading view that growth rate effects of inequality are linked to the institutions governing the economy. We show how income inequality and corruption simultaneously result in a smaller redistributive outcome. We endogenize the exemption level and assess its effect on redistributive outcomes and by implication on growth rates. Clearly, the development of taxes, education and growth variables may be severely damaged by inequality that prevails in a wealth biased system of politics. In a situation where wealth bias in political decision making is prevalent, the tax base is likely to be eroded and lower effective tax rates (per capita tax or per capita transfer) are observed, making it difficult to finance education.

We proceed as follows. We first introduce the economy by specifying production and preferences. Section 5.3 examines the extent of providing tax exemptions and how these exemptions are determined endogenously. In Section 5.4, we also analyze the immediate effects of an increase in the productivity of skilled workers

on tax base, lobbying efforts, pressure for redistribution and its implication for the dynamics of bequests and redistribution. Section 5.5 explains the non-monotonicity of the relation between redistribution and growth. The last section concludes.

5.2 The Model

In this section we describe the economics, politics and the dynamic structure of the society at hand. We introduce a standard two-OLG model of a small open economy where parents are altruistic and leave bequests. We first present a brief description of the technology and behavior of households given the political institutions. Subsequently, we elaborate on the political process.

5.2.1 The Technology

There is a single good that can be produced with a simple linear technology using skilled labour S_t and unskilled labour U_t:

$$Y_t = A_t^u U_t + A_t^s S_t \tag{5.1}$$

Each type of labour is paid its marginal product, that is, $w_t^u = A_t^u$ and $w_t^s = A_t^s$. It is assumed that high skilled labour is more productive than unskilled labour: $w_t^s > w_t^u$. We assume that there is a continuum of knowledge innovations that increases production of skilled and unskilled via learning by doing. That is, knowledge creation is driven by production by skilled and unskilled workers and there are spill overs from one type of workers to the other:

$$\begin{cases} \Delta A_t^s = \theta^s \left(A_t^s S_t\right)^{\phi} \left(A_t^u U_t\right)^{1-\phi} \\ \Delta A_t^u = \theta^u \left(A_t^s S_t\right)^{\pi} \left(A_t^u U_t\right)^{1-\pi} \end{cases} \tag{5.2}$$

The parameters ϕ and π reflect the effect of production (and thus of the existing stock of knowledge) on the success of new knowledge production. We assume that skilled production is more important for the creation of knowledge of the skilled workers than unskilled production (i.e. $0.5 < \phi < 1$) and that the spillover from skilled workers to the unskilled is larger than the spillover from unskilled workers

to the skilled (i.e. $\pi > 1 - \phi$). Note that because of the spill overs, the growth rate of wages of skilled and unskilled workers ($\frac{\Delta A_t^s}{A_t^s}$ and $\frac{\Delta A_t^u}{A_t^u}$ respectively) will be the same in the long run, though the levels of A_t^s and A_t^u will be different. From this we can derive that in the steady state:

$$\frac{A_t^s}{A_t^u} = \left(\frac{\theta^s}{\theta^u}\right)^{\frac{1}{1+\pi-\phi}} \left(\frac{S}{U}\right)^{\frac{\phi-\pi}{1+\pi-\phi}} \tag{5.3}$$

Plugging this into equation (2) gives the following expression for long-run growth:

$$g = \theta^s S \left(\frac{\theta^s}{\theta^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{S}{U}\right)^{\frac{\phi-1}{1+\pi-\phi}} \tag{5.4}$$

Note that the assumptions imply that both production by skilled workers and by unskilled workers raises long-run growth, but that the elasticity of growth with respect to an increase in skilled production is larger than the elasticity with respect to an increase in unskilled production.

5.2.2 The Households

The economy is populated by overlapping generations of individuals, each living for two periods. Each agent has one child, hence the population, N, is constant. Agents consume only in the second period of their life. Furthermore, we will assume that parents are altruistic, i.e. members of a dynasty are linked through bequests left to their children. Agents of a generation differ in the amount that they have inherited from their parents, but are the same in their preferences and abilities. Utility V_t^i of an agent born in period t is assumed to be a function of consumption in the second period of his life (c_{t+1}) and the bequest left to his child (b_{t+1}):

$$V_t^i = \alpha c_{t+1} + (1-\alpha) b_{t+1} \tag{5.5}$$

where α is the share of consumption while $(1-\alpha)$ is left for bequest. In the second period of their life, both skilled and unskilled individuals are endowed with one unit of time. The former supply all their labor endowment in production while the latter spend it either on working (l_t^u) or on lobbying activities (γ_t^u).

$$\gamma_t^u + l_t^u = 1 \tag{5.6}$$

Agents can work as a skilled labourer in the second period of their life if they invest in human capital during the first period. The investment in human capital is indivisible: that is either one invests $h_t > 0$ or one does not invest at all. All investment must be financed out of inheritances, i.e. there is no capital market and hence agents can not borrow against future earnings to finance expenditures on education when young. So only agents with an inheritance $b_t^i \geq h_t$ are able to become skilled. We denote by N_t^s the number of skilled individuals in period t and by $N_t^u = N - N_t^s$ the number of individuals of the same generation (i.e. born in period $t-1$) who remain unskilled. For all other variables we also distinguish between skilled and unskilled agents by the superscript s and u respectively. So the supply of skilled labour is $S_t = N_t^s$ and the supply of unskilled labour is $U_t = N_t^u l_t^u$. Notice that the unskilled lobby some part of their labor endowment while the skilled individual do not lobby.

The government runs a redistribution scheme from the skilled to the unskilled of the same generation as a balanced budget scheme, financed by a tax on wealth and income of the skilled:

$$\Lambda_t = (\tau_t - \beta\tau_t^2)B_t \tag{5.7}$$

where Λ_t = total transfer, $B_t = \int_{h_{t-1}}^{\bar{b}_{t-1}} \left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right] f(b_i)db_i$ is the total income of skilled (total tax base), r is the exogenous interest rate determined in world capital markets and τ_t is income tax while $\beta\tau_t^2$ is a collection cost. The lower boundary of the tax base (h_{t-1}) denote cost of human capital investment. Thus the income of the unskilled is given by:

$$y_i^u = b_{t-1}(1+r) + w_t^u l_t^u + \lambda_t, \tag{5.8}$$

where $\lambda_t = \frac{\Lambda_t}{N_t^u}$ is the per capita transfer for the unskilled individual.

Unlike the unskilled, the skilled invest in human capital in the first period and receive a wage of w_t^s in the second period. The income of a skilled worker is thus

given as:

$$y_i^s = \left[(b_{t-1} - h_{t-1})\,(1+r) + w_t^s\right](1-\tau_t) \tag{5.9}$$

We assume an individual prefers to work as skilled, i.e. we assume $V_t^s > V_t^u$, which implies:[4]

$$w_t^s > \frac{\tau_t(1+r)(b_{t-1} - h_{t-1}) + (1+r)h_{t-1} \; + w_t^u l_t^u + \lambda_t}{1-\tau_t} \tag{5.10}$$

The extreme rich individuals ask for getting exemptions only if the following condition is satisfied

$$\left[(b_{t-1} - h_{t-1})\,(1+r) + w_t^s\right]\varepsilon_i - C_t^i - f > 0 \tag{5.11}$$

where ε_i is an exemption rate that an individual gets, C_t^i is the contribution that individual i provides to the politician in an effort to get exemptions, and f is a fixed cost incurred for the mobilization or organizing the contribution scheme independent of what others do.[5]

5.3 Tax Exemptions

The purpose of this subsection is to link household heterogeneity to redistributive lobbying. It is important to note that we abstract from commitment and persistence. That is, each period the tax rate is determined independently from the tax rates in previous or future periods. The only form of taxes in the model is wealth and income taxes, which are proportional and have collection costs. It is assumed that the government does play an active role in the political process but is also captured by the special interests of the skilled and the unskilled. Moreover, we

[4]Note that this condition involves several endogenous variables. Consequently, it can not be assumed to hold ex ante.

[5]In the literature of interest groups, lobbying costs are studied in three different formats. First, some costs are exogenous and hence fixed. This includes salaries of experts who are demanded to present some briefings to policy makers. The second costs entail groups discretion. That is once a lobby group bears the costs, interest groups expend beyond the minimum necessary to signal their desire. The third cost is imposed by policy makers. In this paper, for the sake of simplicity, we assumed the cost to be fixed.

abstract from free riding effects and assume that the a representative lobby group for the unskilled individual chooses the amount of available resources in influencing the redistributive policy so as to maximize life time utility.

Therefore, we consider a government or policy maker that combines social welfare and the influence of political contributions. To keep the analysis very simple, there is only one group favouring a higher tax. We assume that this lobby group solves its intra-group collective action problems. Moreover, the extreme rich ones are able to ask for exemptions. The contributors will have to satisfy the participation constraint of the government. In other words, its contributions must at least match the government's utility without the policy advocated by the group and contributions should be such that they induce a change. The objective function of the politician reads as follows:

$$V_t = u_t \int_{\underline{b}_{t-1}}^{h_{t-1}} y_i^u(b_i) f(b_i) db_i + z_t \int_{h_{t-1}}^{p_{t-1}} y_i^{sn}(b_i) f(b_i) db_i + x \int_{p_{t-1}}^{\bar{b}_{t-1}} C_i(b_i) f(b_i) db_i \qquad (5.12)$$

where V_t stands for utility of the politician, $u_t = \eta_o^u (\gamma_t^u)^a$ is the weights attached to the unskilled individual; η_o and a are the shift parameter and intensity of the lobbying technology respectively, z_t is the weight given to the skilled nonexempt, which for simplicity is normalized to one (henceforth).[6] The parameter (x) represents the trade-offs between aggregate welfare and contributions. The higher x the greater the weight placed by the government on monetary contributions. Thus x is a malevolence measure which permits lot of exemptions. Both $\underline{b}_{t-1}$ and $\bar{b}_{t-1}$ are the lower and the upper boundaries of the bequest level respectively. Moreover, p_{t-1} is the minimum bequest level required for asking exemptions.

The timing of events is as follows:

At $t = 0$, individuals are organized into various political activities. The unskilled mobilize their resources so as to get political support or impeding the mo-

[6] In considering the utility of the general public, for simplicity we assume that the politician attaches a weight of zero to the skilled exempted as it would not alter any of our qualitative results.

bilization of their opponent. i.e. strikes, lockout etc. by investing time.

At $t = 1$, by taking into account the welfare of individuals in the economy and the monetary contribution, the government sets the tax rate to maximize its own utility.

At $t = 2$ of the game, the high income individuals who are not subject to tax, instead participate in monetary contribution that requires an entry cost which could be relatively fixed and outside the control of these individuals. We assume that only those extremely rich ones are able to participate in monetary contribution and are able to ask for exemptions.[7] The politician and the contributors determine the rate of exemptions. The policy maker and the contributor bargain over (ε_t^i) but not over (τ_t) albeit the tax rate affects the domain of the exemption rate. A typical explanation given for this is that officials can get utility from bribes. Let's first see the result in cases where the politician has no incentive to provide exemptions.

Case I: No Exemption

We first explore the scenario where the politician puts a lot of concern for the utility of the general public. The first step is to solve for the set of efficient bargains that can be reached between each contributor and the politician in $t = 2$. The politician has the possibility of choosing $\varepsilon_t^i = 0$ and place a higher relative weight on the overall distributional concern. This is particularly true if the weights attached to the unskilled (u_t) is high. In this case $\varepsilon_t^i = 0$ and hence $C_t^i = 0$. The other possible outcome in stage 2 is that the contributors and the politicians reach an agreement i.e. the government provides exemptions. We postpone this, however, until the next subsection.

The objective function now reads as:

$$V_t = u_t \int_{\underline{b}_{t-1}}^{h_{t-1}} y_t^u(b_i) f(b_i) db_i + \int_{h_{t-1}}^{\bar{b}_{t-1}} y_t^{sn}(b_i) f(b_i) db_i \tag{5.13}$$

[7] Empirical evidence shows that in a society where asset ownership is concentrated in a small elite, asset owners can use their wealth to lobby the government for favorable preferential tax treatments of their assets. (cf. Benabou, 2000)

Assuming a uniform density distribution in the bequest function, $f(b_i) = \frac{1}{b_{t-1} - b_{t-1}}$, the politician chooses the tax rate by differentiating (5.13) with respect to τ_t and we get the following equilibrium tax rate:

$$\tau_t^* = \frac{u_t - 1}{2\beta u_t} \tag{5.14}$$

As one can notice from the equilibrium tax rate of equation (5.14)[8], we have the following signs after taking the first-order and second-order derivatives:

$$\tau_t^u \equiv \frac{1}{2\beta u_t^2} > 0, \ \tau_t^{uu} \equiv -\frac{1}{2\beta u_t^3} < 0, \tag{5.15}$$

If the unskilled invests more in lobbying, he is *ceteris paribus* more successful in achieving his objective, but the marginal effect of these rent-seeking investments is decreasing in absolute value. We assume that unskilled individuals maximize as a group their lifetime utility by choosing the optimal amount of lobbying effort. That is, in the initial stage/period agents take into account the utility function of the politician and compete for favor through mobilization. The first-order condition for the lobby group representing the unskilled in period t is:

$$\gamma_t^u = (\frac{a}{2\beta\eta^2} \frac{B_t}{N_t^u w_t^u})^{\frac{1}{2a+1}} \tag{5.16}$$

where B_t is the taxable income when there is no exemption. For a given tax rate, we can rewrite the equation above as:

$$\gamma_t^u = \frac{a(1 - 2\beta\tau_t)^2 F}{2\beta} \frac{N_t^s}{N_t^u} \frac{1}{w_t^u} \tag{5.17}$$

where F is the average taxable income when there is no exemption, $\frac{N_t^s}{N_t^u}$ is the dependency ratio and $\frac{1}{w_t^u}$ is the shadow cost of lobbying for the unskilled. The per capita transfer is the same for every unskilled individual and hence the amount of hours they lobby is the same. Equation (5.17) states that, for given τ_t, for the unskilled the marginal benefit of lobbying depends on the income of the skilled as well as on the number of skilled relative to unskilled individuals. As a result, the unskilled will, for example, lobby more if the number of skilled rises. In the next

[8] For the derivation of the equilibrium tax rate see Appendix B.

subsection we discuss the case where the politician offers exemptions in return to monetary contributions.

Case II. Full Exemption

Continuing the backward induction begun in the previous subsection, we look at a case where the politician puts a lot of weight on monetary contributions.

Proposition 5.1 *When $x - u_t > 0$, there will be full exemption for the extremely high income groups.*

Proof. See Appendix A. ■

An assumption is made i.e. $p_{t-1} > h_{t-1}$, where $p_{t-1} = \frac{fx}{(1+r)(x-u_t)\tau_t} + h_{t-1} - \frac{w_t^s}{(1+r)}$ and this requires that $\frac{fx}{(x-u_t)\tau_t} > w_t^s$. Skilled individuals with income $(b_{t-1} - h_{t-1})(1+r) + w_t^s < \frac{fx}{(1+r)(x-u_t)\tau_t}$ do not give contributions and hence do not get exemptions. This is because, when the income of the skilled is less than $\frac{fx}{(1+r)(x-u_t)\tau_t}$, it does not pay enough for him/her to offer a politician to make him indifferent between giving exemptions and gathering taxes.

Under this scenario the politician is assumed to maximize his utility function which is a weighted average of the general public and the total of contributions as shown in equation (5.12). In this case, politicians will desire to set a higher tax rate so as to raise their bargaining position against the contributors. The efficiency gains of the equilibrium tax rate, however, are subject to the extent of the magnitude on how the surplus is distributed. For simplicity, here we assume the surplus of the bargaining is received by the policy maker i.e. $\bar{C} = [(b_{t-1} - h_{t-1})(1+r) + w_t^s]\tau_t - f$. The policy maker maximizes the target function subject to his budget constraint (5.7), so that the transfer must be financed from taxes on skilled workers who are non-exempt. The equilibrium tax rate arising out of the above political process is:

$$\tau_t = \frac{(u_t - 1)E_t + x\Gamma_t}{2\beta E_t u_t} \tag{5.18}$$

where $E_t = \int_{h_{t-1}}^{p_{t-1}} [(b_{t-1} - h_{t-1})(1+r) + w_t^s] f(b_i) db_i$ is the total income of skilled non-exempt (total tax base), and $\Gamma_t = \frac{d}{d\tau}(\int_{p_{t-1}}^{\bar{b}_{t-1}} [\overline{C}] f(b_i) db_i)$ is the total gross income of the exempt group.[9] As one can notice from the equilibrium tax rate of equation (5.18), we have the following signs after taking the first-order and second-order derivatives:

$$\tau_t^u \equiv \frac{E_t - x\Gamma_t}{2\beta u_t^2 E_t} > 0, \tau_t^{uu} \equiv -\frac{(E_t - x\Gamma_t)}{2\beta u_t^3 E_t} < 0, \tag{5.19}$$

A non-negative constraint should hold $(E_t - x\Gamma_t > 0)$ so that for given tax base an increase in lobbying effort of the lobby group representing the unskilled is transformed into a higher tax i.e. $\tau_t^u > 0$. Skilled individuals above the threshold level of p_{t-1} (which insulates skilled who are subject to tax and those who are exempted) are not subject to tax and this decreases the amount of income that is taxable at the initial equilibrium. Allowing on exemptions, therefore, reduces the tax base from B_t to E_t $[E_t < B_t]$. Since the unskilled lobby as a group in response to the size of the tax base, a narrow tax base implies lower incentives to invest in lobbying leading to a decline in the value of γ_t^u when the politician permits exemptions. This is easily observed from the optimality condition of the lobby group representing unskilled individual:

$$\gamma_t^u = \left(\frac{a(E_t - x\Gamma_t)^2}{2\eta^2 \beta N_t^u w_t^u E_t} \right)^{\frac{1}{2a+1}} \tag{5.20}$$

For a given N_t^u and w_t^u, a comparison of (5.16) and (5.20) reveals that $(\gamma_t^u)^{ne} > (\gamma_t^u)^e$ will hold since the tax base $B_t > E_t$. This is because the optimal lobby effort is determined by balancing the marginal cost of lobbying with the marginal benefit of transfers. Where $(\gamma_t^u)^{ne}$ and $(\gamma_t^u)^e$ are optimum lobby effort both under no exemption and with exemptions respectively. Nevertheless, the decrease in

[9] We assume that when the politician decides the tax rate, he does not take into account the indirect effect of tax rate i.e. $\frac{\partial p_{t-1}}{\partial \tau_t} = 0$.

the tax rate due to a lower lobbying effort $[(\gamma_t^u)^e < (\gamma_t^u)^{ne}]$ under exemptions is compensated by the fact that the government would want to charge a higher tax as it increases contributions. A comparison of the magnitude of the equilibrium tax rate under exemption and no exemption requires not only knowing the magnitude of the optimal hours spent on lobbying but also the contribution levels. For given γ_t^u, for example, the government is willing to undertake a higher tax because raising taxes lead to a higher contributions. This is easily observed from rewriting (5.14) and (5.18):

$$\begin{cases} \tau_t^{ne} = \frac{1}{2\beta} - \frac{1}{2\beta u_t} \\ \tau_t^{e} = \frac{1}{2\beta} - \frac{1}{2\beta u_t} + \frac{x\Gamma_t}{2\beta E_t u_t} \end{cases} \tag{5.21}$$

where τ_t^{ne} and τ_t^e are equilibrium tax rates under no exemptions and exemptions respectively. For given γ_t^u, a comparison of τ_t^{ne} and τ_t^e reveals that $\tau_t^e > \tau_t^{ne}$ holds due to the presence of the last term $\frac{x\Gamma_t}{2\beta E_t u_t}$ observed in the value of the equilibrium tax rate τ_t^e. The intuition behind this result is corrupt politicians in states with weak constitutional order seem to be particularly inclined to extract political rents or bribes by charging a higher tax. This will result to have an ambiguous effect on the size of equilibrium tax rate between exemption and the no exemption case. This is summarized in the following proposition:

Proposition 5.2 *A decrease in the tax base caused by the presence of exemptions has an ambiguous effect on the equilibrium tax rate compared to the no exemption case. If the distribution is sufficiently skewed to the right i.e. if* $\frac{\left(\int_{p_{t-1}}^{\bar{b}} y_t^{se}(b_i) f(b_i) db_i\right)}{\left(\int_{h_{t-1}}^{p_{t-1}} y_t^{sn}(b_i) f(b_i) db_i\right)} \geq \frac{\tau_t^e - \tau_t^{ne}}{\tau_t^{ne}}$ *holds, then exemptions reduce tax revenues.*

Proof. See Appendix C. ■

The intuition behind proposition 5.2 is that, for given tax rates exemptions could be a serious concern when the degree of inequality is skewed to the right. In this case, the percentage of skilled people who are subject to tax will be lower and consequently the tax base shrinks. When the income of exempt groups is

large enough compared to the tax base, exemptions will have harmful effects to tax revenues and thus transfers. Empirical evidence shows that the distribution of income in the upper range is very well fitted by the Pareto density, while log-normal distribution for the rest of the distribution (Lambert, 1993).

5.4 Technological Shock

As already noted, individuals who inherit an amount larger than h_{t-1} are able (and willing) to invest in human capital and become skilled in the second period of their life. Consequently, the distribution of inheritances in period t determines the number of skilled in period $t+1$. Let D_t be this distribution: $\int_0^\infty dD_t(b_t) = N$, then the number of skilled in the next period is:

$$N_{t+1}^s = \int_h^\infty dD_t(b_t) \tag{5.22}$$

and the number of unskilled:

$$N_{t+1}^u = \int_0^h dD_t(b_t) \tag{5.23}$$

The distribution of wealth at time t not only determines the number of skilled and unskilled in period $t+1$, but also affects redistribution, technological spill overs and growth in both sectors, and thus indirectly the distribution of inheritances in future periods. These dynamic effects are quite complex. In this section we neglect the effects on technology and growth (i.e. we assume $\theta^s = \theta^u = 0$ so that w^u, w^s and h are constant) and discuss the dynamic relation between redistribution and wealth. Notice that the contribution levels are subject to the extent of the magnitude on how the surplus is distributed. Since for simplicity, we assume the surplus of the bargaining is received by the policy maker, the income of exempt individuals will be the same as the income of tax payers. To see this substitute the contribution level $\bar{C}_i = [(b_{t-1} - h_{t-1})(1+r) + w_t^s]\tau_t - f$ in the income of exempt groups

$$[(b_{t-1} - h_{t-1})(1+r) + w_t^s]\tau_t - ([(b_{t-1} - h_{t-1})(1+r) + w_t^s]\tau_t - f) - f > 0 \tag{5.24}$$

the above equation is equivalent to the income of the skilled worker (5.9). Therefore, intra-group wealth levels will converge into two income groups.[10] The dynamics in both cases (when there is no exemption and exemption) can be described by:

$$b_{t+1}^{u} = (1-\alpha)(1+r)\, b_t^{u} + q_t^{u} \text{ if } b_t < h \tag{5.25A}$$

$$b_{t+1}^{s} = (1-\alpha)(1+r)(1-\tau) b_t^{s} + q_t^{s} \text{ if } b_t \geq h \tag{5.25B}$$

where

$$\begin{cases} q_t^{u} \equiv (1-\alpha)\left[l_t^{u} w^{u} + \lambda_t\right] \\ q_t^{s} \equiv (1-\alpha)(1-\tau_t)\left[w^{s} - (1+r)\, h\right. \end{cases} \tag{5.26}$$

We assume that the dynamic equation is stable,

$$(1-\alpha)(1+r) < 1$$

Moreover, we assume that initially $q_t^{u} < [1-(1-\alpha)(1+r)]h$ and $q_t^{s} < [1-(1-\alpha)(1+r)(1-\tau)]h$. That is, we assume that polarization prevails and children of unskilled parents will be unskilled and children of skilled parents will become skilled.

In this case, the number of skilled and unskilled is constant, and hence (given that the wages are also assumed to be constant) the tax rate and q^{u} and q^{s} will be constant. As a result, equation $(5.25A)$ and $(5.25B)$ are piecewise linear function that intersects the 45^{o}-line two times, at the equilibria, $b_u^{*} \equiv \frac{q^{u}}{1-(1-\alpha)(1+r)}$ and $b_s^{*} \equiv \frac{q^{s}}{1-(1-\alpha)(1+r)(1-\tau)}$. So, in the long run, wealth levels within the groups converge, but there is complete dichotomy between the two groups. The long-run level of average wealth can be expressed as $\bar{b} = b_u^{*} + \frac{N^{s}}{N}\left(b_s^{*} - b_u^{*}\right)$,which is increasing with $\frac{N^{s}}{N}$ if b_u^{*} and b_s^{*} are taken to be constant. However, a change in the number of skilled will shift the political equilibrium and thus affect b_u^{*} and b_s^{*}. In particular, an increase

[10] It is possible that when there is an exemption the distribution of bequests could converge into three steady states equilibria. When the contributors take the surplus or if the surplus is shared efficiently between politicians and contributors that will result to a higher income for the skilled exempt individuals than the skilled non-exempt groups. So, in the long run, wealth levels within the groups converge, but there is complete dichotomy between the three income groups.

in the number of skilled will decrease the tax rate, and lower b_u^* and raise b_s^*. So the relation between redistribution and average wealth is not straightforward.

Technological shock that increases the wage of the skilled can have different effects depending on the institutional set up of the countries. Differences will result between exemption and no exemption case, whenever there is a technological shock that increase the wage of skilled individuals. In societies where weak institutions govern their economies, individuals could ask exemptions to escape from paying taxes which lowers the tax base E_t, reducing the accumulation of human capital. This leads to the following proposition.

Proposition 5.3 *With exemptions a technological shock that results an in increased wage differential: i) reduces tax base* $\frac{\partial E_t(w_t^s)}{\partial w_t^s} < 0$; *ii) increases monetary contributions iii) reduces lobby effort of unskilled individual* $\frac{\partial \gamma_t^u(w_t^s)}{\partial w_t^s} < 0$; *iv) has an ambiguous effect on both tax revenue collected and per capita transfer. v) However, in case there is no exemption, an increase in wages increases taxable income* $\frac{\partial B_t(w_t^s)}{\partial w_t^s} > 0$, *increase lobby effort of unskilled individual* $\frac{\partial \gamma_t^u(w_t^s)}{\partial w_t^s} > 0$ *and therefore both tax revenue and per capita transfer will also be higher.*

Proof. See Appendix D. ■

When the politicians do not provide exemptions the dynamics is closely related to the one in chapter 4. We have demonstrated, in chapter 4, that the effect of a once-and-for-all increase in w^s tend to increase the net income of both the skilled and the unskilled.

With the case of exemptions, however, things are different. The increase in income may or may not be large enough to allow the children of the skilled non exempt with the highest inheritance to ask for exemptions. When the children of the nonexempt skilled are able to ask exemptions, this shifts the political equilibrium. First, it might cause some of the children of the non exempt to ask for exemption because the incentive to ask for exemption is greater than paying a tax. As a result, children with an inheritance just below (p_{t-1}), will consequently be able to ask for exemptions and in the next period the number of skilled exempted will be higher.

This is reflected by $\frac{\partial p_{t-1}}{\partial w_t^s} < 0$. Second, the tax base declines as some individuals ask for exemptions. And this will result in a higher dependency ration as the per capita transfer declines.

Notice that in this subsection we abstracted from technological spill-overs and growth. However, it is evident that if we take growth into account, the growth rate in the new steady state will be different from the initial growth rate. It is not evident what the exact effect on growth is, however. Therefore, in the next section, we analyze the relation between redistribution, the size of both sectors and growth.

5.5 The Relation between Tax, Education and Growth

The aim of this section is to illustrate the relation between redistribution, technological spill-overs, and economic growth. We first analyze the relation between the long-run growth rate and the number of skilled and unskilled, for given amounts of time spend on lobbying by both groups. Subsequently, we analyze the relation between growth and the tax rate.

Increasing the number of skilled *ceteris paribus* increases skilled production which, due to spill-over effects, leads to higher growth rates in both sectors. However, given total population size, an increase in the number of skilled implies a decrease in the number of unskilled which exerts downward pressure on the growth rates in both sectors. As a result, an increase in the number of skilled only increases growth if the number of unskilled is relatively large, i.e. if the number of skilled is below its optimal level. This is summarized in the following proposition.

Proposition 5.4 *An increase in the number of skilled leads to higher long-run growth if and only if* $N^s < \delta N$.

Proof. See Appendix E. ■

This proposition assumes the amount of time individuals spend on lobbying to be constant. However, we know from the political model that, in general, changes

in the size of both lobby groups affect lobby efforts. Consequently, given wages of skilled and unskilled, there is a relation between group size and the tax rate. Using the corresponding first-order conditions to substitute out γ_t^u, we can specify the relation between group size and the tax rate. Combining this with the relation between group size and growth as summarized in Proposition 4, we are able to derive a relation between the tax rate and short run i.e. given N^s, N^u, w_t^s and w_t^u growth rate which is non-linear.

$$g = \Delta(\frac{1}{1-(1-2\beta\tau^2)\,\Psi})^{\frac{\phi-1}{1+\pi-\phi}} \tag{5.27}$$

where $\Delta = \theta^s N^s \left(\frac{\theta^s}{\theta^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{N^s}{N^u}\right)^{\frac{\phi-1}{1+\pi-\phi}}$.[11] The relationship between taxes and growth is non linear. Moreover, the model predicts that as tax revenues are higher, human capital will increase. This is because, taxation is redistributive in the model. That is, taxes are levied in a non-lump sum fashion whereas the tax revenue is redistributed lump sum to the unskilled individuals and hence a higher bequest for their children enabling them to cover the cost of education. However, higher taxes could also discourage labour supply i.e. lobbying efforts that slows down production in the unskilled sector is an increasing function to tax rates. Besides, higher taxes are also associated with higher collection cost. The non monotonic relation between taxes and growth described by equation (5.27) is also depicted in Figure 5.1. For given Δ and Ψ, Figure 5.1 displays the function $g(\tau)$, which is non-linear in its nature.

In the long run, the difference in growth rate of skilled and unskilled decreases over time due to spill over effect and eventually the wage gap stabilizes and the economy reaches the steady state. Consequently the lobbying efforts (γ_t^u) will stabilize. Since the tax rates follow the motion of the γ_t^u, τ_t will also be stabilized to its steady state values.

[11] See Appendix F for the derivation.

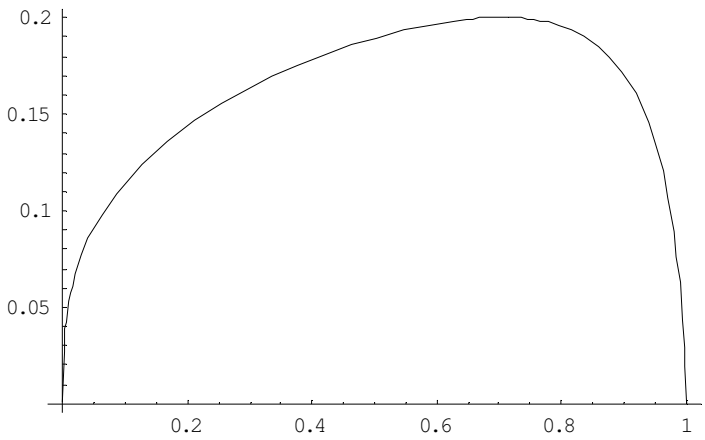


Figure 5.1: Short Run Relations between Taxes and Growth

5.5.1 Concluding Remarks

This paper presents a model allowing one to analyze the joint determination of inequality, taxes, human capital and growth. We consider the political economy of redistribution between three income groups in a dynamic economy. Chapter 5 seeks to explain the effect of corruptibility (exemptions) on policy outcomes in a two-sector endogenous growth model where growth is driven by human capital, investment in human capital is indivisible and capital markets are missing. In such an economy, investment in human capital tends to be inefficiently low and redistribution may have significant effects on growth.

The theoretical analysis revealed that a higher inequality does not necessarily yield a higher tax revenue although the tax rate might be higher. The effect could even be reversed if inequality emerges in a situation where there is a wealth bias in the political system. The political outcome is dependent on the differences in the balance between the costs and benefits of lobbying. If technological progress increases the wage gap between the skilled and the unskilled, for example, this will not necessarily result in more active political support. High technological progress means a higher income for the skilled individuals which in turn means a higher incentive to ask exemptions. Thus, an increase in inequality raises the proportion of skilled individuals which are not subject to tax. Moreover, it also raises the amount of resources devoted to rent seeking.

We showed how income inequality and corruption results in a smaller redistributive outcome. The channel we suggest and examine is to endogenize the determination of exemptions. Clearly, the development of education, taxes and growth variables may be severely damaged by inequality that prevails in wealth biased system of politics. In a situation where wealth bias in political decision making is prevalent, the tax base is likely to be eroded and lower effective tax rates (per capita tax or per capita transfer) are observed, making it difficult to finance education.

Appendix to Chapter 5

Appendix A: Proof of Proposition 5.1.

To characterize the efficient bargain, it is simply necessary to note that the individual rationality constraints of the agents are:

$$\left[\left(b_{t-1}-h_{t-1}\right)(1+r)+w_t^s\right]\varepsilon_t^i - C_t^i - f \geqslant 0 \tag{A1}$$

$$-\left[\left(b_{t-1}-h_{t-1}\right)(1+r)+w_t^s\right]u_t\varepsilon_t^i + xC_t^i \geqslant 0 \tag{A2}$$

$A2$ requires that the politician receives at least his reservation utility (normalized, recall, at zero) irrespective of contributions and the lost tax revenue. The distribution of contributions is subject to the choice among efficient bargains. If the extreme rich one is able to extract all surplus from the politician, he will pay $C_t^i = \frac{[(b_{t-1}-h_{t-1})(1+r)+w_t^s](u_t)\varepsilon_t^i}{x}$, the minimum he needs to make the politician willing to carry out the policy. If the politician captures the surplus, then the contribution level will be $-f + \left[\left(b_{t-1}-h_{t-1}\right)(1+r)+w_t^s\right]\varepsilon_t^i$.

Exemption is henceforth called admissible iff it satisfies A1 and A2 and the set of C_t^i is:

$$C_t^i \in \left\{ \frac{\left[\left(b_{t-1}-h_{t-1}\right)(1+r)+w_t^s\right]u_t\varepsilon_t^i}{x},\ \left[\left(b_{t-1}-h_{t-1}\right)(1+r)+w_t^s\right]\varepsilon_t^i - f \right\} \tag{A3}$$

A necessary condition for $(A3)$ to be non empty is

$\frac{[(b_{t-1}-h_{t-1})(1+r)+w_t^s]u_t\varepsilon_t^i}{x} \leq \left[\left(b_{t-1}-h_{t-1}\right)(1+r)+w_t^s\right]\varepsilon_t^i - f$, which can be expressed as:

$$b_{t-1} \geq \frac{fx}{(1+r)(x-u_t)\varepsilon_t^i} + h - \frac{w_t^s}{1+r} \tag{A4}$$

It follows that, there will be no individual for which $\frac{fx}{(1+r)(x-u_t)\varepsilon_t^i} + h - \frac{w}{1+r} > b_{t-1}$ there exists a bargain that fulfills the individual rationality conditions. Therefore

individuals with income lower than $\frac{fx}{(1+r)(x-u_t)\varepsilon_t^i} + h_{t-1} - \frac{w_t^s}{1+r}$ will give no contributions and get no exemptions. Now when $(A4)$ is satisfied, there will be a set of efficient bargains which (weakly) Pareto dominate the reservation utility of the politician, and thus we shall expect $\varepsilon_t^i > 0$ in these cases.

It is left to establish that when $(A4)$ is satisfied then full exemption $\varepsilon_t^i = \tau_t$ is granted. To see this, we write down the utility possibility frontier as the solution to:

$$Max\left\{\left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right]\varepsilon_t^i - C_t^i - f\right\} \tag{A5}$$

$$\begin{aligned} \text{Subject to } -\left[((b_{t-1} - h_{t-1})(1+r) + w_t^s)u_t\right]\varepsilon_t^i + xC_t^i &\geqslant 0, \\ \varepsilon_t^i &\leq \tau_t \end{aligned} \tag{A6}$$

Substituting the first constraint in the objective function:

$$Max\left\{\left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right]\varepsilon_t^i - \frac{\left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right](u_t)\varepsilon_t^i}{x} - f\right\} \tag{A7}$$

the maximand is linear in ε_t^i if $x - u_t$ is greater than zero and thus $\varepsilon_t^i = \tau_t$. If $u_t > x$, the politician will not give exemptions.

Appendix B: Derivation of the equilibrium tax rate.

Under no exemption the politician will set the tax rate to maximize:

$$V_t = u_t \int_{\underline{b}_{t-1}}^{h_{t-1}} y_t^u(b_i) f(b_i) db_i + z_t \int_{h_{t-1}}^{\bar{b}_{t-1}} y_t^{sn}(b_i) f(b_i) db_i \tag{B1}$$

substituting equation (5.7), (5.8) and (5.9) in B1 we have

$$
\begin{aligned}
V_t(\tau_t) &= u_t\Big(\int_{\underline{b}_{t-1}}^{h_{t-1}} [(b_{t-1}-h_{t-1})(1+r)+w_t^u \\
&\quad +\frac{(\tau_t-\beta\tau^2)}{N^u}\int_{h_{t-1}}^{\bar{b}_{t-1}} [(b_{t-1}-h_{t-1})(1+r)+w_t^s]\, f(b_i)db_i]f(b_i)db_i) \\
&\quad +z_t(1-\tau_t)\int_{h_{t-1}}^{\bar{b}_{t-1}} [(b_{t-1}-h_{t-1})(1+r)+w_t^s]\, f(b_i)db_i \qquad \text{(B2)}
\end{aligned}
$$

The derivative of (B2) with respect to the tax rate

$$
\begin{aligned}
\frac{\partial V_t(\tau_t)}{\partial\tau} &= u_t\frac{d}{d\tau_t}\int_{\underline{b}_{t-1}}^{h_{t-1}} \frac{(\tau_t-\beta\tau_t^2)}{N^u}\Big[\int_{h_{t-1}}^{\bar{b}_{t-1}} [(b_{t-1}-h_{t-1})(1+r)+w_t^s]\, f(b_i)db_i]f(b_i)db_i \\
&\quad +z_t\frac{d}{d\tau_t}\int_{h_{t-1}}^{\bar{b}_{t-1}} [(b_{t-1}-h_{t-1})(1+r)+w_t^s](1-\tau_t)f(b_i)db_i \qquad \text{(B3)}
\end{aligned}
$$

simplifying $B3$ gives us:

$$u_t(1-2\beta\tau_t)B_t = z_tB_t \qquad \text{(B4)}$$

where B_t is $\int_{h_{t-1}}^{\bar{b}_{t-1}} [(b_{t-1}-h_{t-1})(1+r)+w_t^s]\, f(b_i)db_i$. Rearranging and rewriting $B4$ and normalizing $z_t=1$, the equilibrium tax rate will be:

$$\tau_t^* = \frac{u_t-1}{2\beta u_t} \qquad \text{(B5)}$$

Following the same procedure the equilibrium tax rate when there is exemption will be:

$$\tau_t^* = \frac{(u_t-1)E_t + x\Gamma_t}{2\beta u_t E_t} \qquad \text{(B6)}$$

Appendix C. Proof of Proposition 5.2

The tax base under no exemption is always higher than the tax base when there is exemption as $p_{t-1} > h_{t-1}$. Suppose that τ_t^{ne} and τ_t^e are the equilibrium tax rates

under no-exemption and exemptions respectively. If $\tau_t^{ne} > \tau_t^e$, then it is evident that revenue collected under no exemption will always be higher. However, when $\tau_t^e > \tau_t^{ne}$ and if the following equation is satisfied, tax revenue collected under no exemption case will still be higher.

$$\frac{\left(\int_{p_{t-1}}^{\bar{b}} y_t^{sn}(b_i) f(b_i) db_i\right)}{\left(\int_{h_{t-1}}^{p_{t-1}} y_t^{sn}(b_i) f(b_i) db_i\right)} \geq \frac{\tau_t^e}{\tau_t^{ne}} - 1 \tag{C1}$$

From C1 it follows that:

$$\tau_t^{ne}\left(\int_{p_{t-1}}^{\bar{b}} y_t^{sn}(b_i) f(b_i) db_i\right) \geq (\tau_t^e - \tau_t^{ne})\left(\int_{h_{t-1}}^{p_{t-1}} y_t^{sn}(b_i) f(b_i) db_i\right) \tag{C2}$$

From C2 it follows that:

$$\tau_t^{ne}\left(\int_{h_{t-1}}^{p_{t-1}} y_t^{sn}(b_i) f(b_i) db_i + \int_{p_{t-1}}^{\bar{b}} y_t^{sn}(b_i) f(b_i) db_i\right) \geq \tau_t^e\left(\int_{h_{t-1}}^{p_{t-1}} y_t^{sn}(b_i) f(b_i) db_i\right) \tag{C3}$$

Rearranging C3 gives,

$$\tau_t^{ne}\int_{h_{t-1}}^{\bar{b}_{t-1}} \left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right] f(b_i) db_i] \geq \tau_t^e \int_{h_{t-1}}^{p_{t-1}} \left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right] f(b_i) db_i] \tag{C4}$$

From equation C4, it is easy to see that the revenue collected under exemption is lower than when the government does not provide exemptions.

Appendix D. Proof of Proposition 5.3 (i)

Technological shock that increase the wage of skilled reduces the tax base i.e. $\frac{\partial E(w_t^s)}{\partial w_t^s} < 0$. To see this, we write the tax base in terms of w_t^s:

$$E_t(w_t^s) = \int_{h_{t-1}}^{p(w_t^s)_{t-1}} \left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right] f(b_i) db_i \tag{D2}$$

Taking the partial derivative of $E_t(w_t^s)$ with respect to w_t^s and using the rule of Leibniz gives:

$$\begin{aligned} \frac{\partial E_t(w_t^s)}{\partial w_t^s} &= \frac{d}{dw_t^s}\Big(\int_{h_{t-1}}^{p(w_t^s)_{t-1}} \left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right] f(b_i) db_i \\ &\quad + \Big(\left[\left(p(w_t^s)_{t-1} - h_{t-1}\right)(1+r) + w_t^s\right] f(p_{t-1})\Big) \end{aligned} \tag{D3}$$

Taking the derivative of D3 yields:

$$\begin{aligned} \frac{\partial E_t(w_t^s)}{\partial w_t^s} &= \Big(\int_{h_{t-1}}^{p(\tau)_{t-1}} f(b_i) db_i \\ &\quad + \frac{\partial p_{t-1}}{\partial w_t^s}\Big(\left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right] f(p_{t-1})\Big)\Big) \end{aligned} \tag{D4}$$

Integrating our result in D4 results to:

$$\frac{\partial E_t(w_t^s)}{\partial w_t^s} = \frac{1}{(\bar{b}_{t-1} - \underline{b}_{t-1})} \left\{ p_{t-1} - h_{t-1} - \frac{1}{1+r}\left[(p_{t-1} - h_{t-1})(1+r) + w_t^s\right] \right\} \tag{D5}$$

After some manipulation, D5 can be written as:

$$\frac{\partial E_t}{\partial w_t^s} = -\frac{1}{(\bar{b}_{t-1} - \underline{b}_{t-1})} \left(\frac{w_t^s}{1+r} \right) < 0 \tag{D6}$$

From D6 it is easy to see that the tax base declines as a result of technological shock. Next we need to determine the signs of $\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s}$ and $\frac{\partial \gamma_t^u}{\partial w_t^s}$ in order to analyze the effect of an increase in wages on tax revenue and transfer.

Proof of Proposition 5.3 (ii)

We now that when the politician captures the surplus, the total contributions are:

$$I_t(w_t^s) = \int_{p_{t-1}}^{\bar{b}_{t-1}} \left(\left[(b_{t-1} - h_{t-1})(1+r) + w_t^s\right] \tau_t - f \right) f(b_i) db_i \tag{D7}$$

where $I_t(w_t^s)$ = total contributions. Differentiating $(D7)$ with respect to w_t^s yields:

$$\frac{\partial I_t(w_t^s)}{\partial w_t^s} = \tau_t(\int_{p_{t-1}}^{\bar{b}_{t-1}} f(b_i)db_i - \frac{\partial p_{t-1}}{\partial w_t^s}([(p_{t-1} - h_{t-1})(1+r) + w_t^s] f(p_{t-1}))) \quad \text{(D8)}$$

Integrating our result in D8 produces:

$$\frac{\partial I_t(w_t^s)}{\partial w_t^s} = \frac{\tau_t}{(\bar{b}_{t-1} - \underline{b}_{t-1})} \left\{ \bar{b}_{t-1} - p_{t-1} + \frac{1}{(1+r)}[(p_{t-1} - h_{t-1})(1+r) + w_t^s] \right\} \quad \text{(D9)}$$

Rearranging and rewriting, we have that

$$\frac{\partial I_t(w_t^s)}{\partial w_t^s} = \tau_t \frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s} > 0 \quad \text{(D10)}$$

where $\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s} = \frac{(\bar{b}_{t-1} + w_t^s - h_{t-1})}{\bar{b}_{t-1} - \underline{b}_{t-1}} > 0$.

Proof of proposition 5.3 (iii)

To see that the sign of $\frac{\partial \gamma_t^u}{\partial w_t^s}$ is negative, simplifying and suppressing the constants to m, we can write (5.20) as follows:

$$\gamma_t^u = [m(E_t - 2x\Gamma_t + \frac{x^2\Gamma_t^2}{E_t})]^{\frac{1}{2a+1}} \quad \text{(D12)}$$

Taking the partial derivative of γ_t^u with respect to w_t^s gives:

$$\begin{aligned} \frac{\partial \gamma_t^u(w_t^s)}{\partial w_t^s} &= \frac{m}{2a+1}\left(\frac{m(E_t(w_t^s) - x\Gamma_t(w_t^s))}{E_t(w_t^s)}\right)^{-\frac{2a}{2a+1}} \\ &\left\{ (\frac{\partial E_t(w_t^s)}{\partial w_t^s} - 2x\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s} + x^2 \frac{(2\Gamma_t(w_t^s)E_t(w_t^s)\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s} - \Gamma_t^2(w_t^s)\frac{\partial E_t(w_t^s)}{\partial w_t^s})}{[E_t(w_t^s)]^2} \right\} \end{aligned} \quad \text{(D13)}$$

Rewriting D13 yields:

$$\frac{\partial E(w_t^s)}{\partial w_t^s}[1 - \frac{x^2\Gamma_t(w_t^s)^2}{E_t(w_t^s)^2}] + \frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s}[-2x + 2\frac{x^2\Gamma_t(w_t^s)}{E_t(w_t^s)}] \quad \text{(D14)}$$

The first term in D14 is positive, to see this we re-write D14 in the following way:

$$\frac{\partial E(w_t^s)}{\partial w_t^s}[\frac{(E_t(w_t^s)-x\Gamma_t(w_t^s))(E_t(w_t^s)+x\Gamma_t(w_t^s))}{E_t(w_t^s)}]+\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s}[2x\frac{(x\Gamma_t(w_t^s)-E_t(w_t^s))}{E_t(w_t^s)}] \tag{D15}$$

From D15 the first term in the bracket is positive as we impose the non-negative constraint i.e. $(E_t(w_t^s)-x\Gamma_t(w_t^s))>0$. So the first expression is negative since $\frac{\partial E(w_t^s)}{\partial w_t^s}<0$. Moreover, the expression in the second bracket of D15 is negative while $\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s}>0$ suggesting that $\frac{\partial \gamma_t^u(w_t^s)}{\partial w_t^s}<0$.

Proof of Proposition 5.3 (iv)

The tax revenue denoted as $TR_t(w_t^s)$ (henceforth) under full exemption is just the tax rate (5.18) times the tax base $E_t(w_t^s)$. By substituting (5.18) into the tax revenue, we obtain an expression for $TR_t(w_t^s)$:

$$TR_t(w_t^s)=\left\{\frac{(u_t(w_t^s)-1)E_t(w_t^s)+x\Gamma_t(w_t^s)}{2\beta E_t(w_t^s)u_t(w_t^s)}\right\}E_t(w_t^s) \tag{D16}$$

Rewriting D16 we have that

$$TR_t(w_t^s)=\frac{1}{2\beta}E_t(w_t^s)-\frac{1}{2\beta}\frac{E_t(w_t^s)}{u_t(w_t^s)}+\frac{x\Gamma_t(w_t^s)}{2\beta u_t(w_t^s)} \tag{D17}$$

Differentiating D17 with respect to w_t^s yields

$$\begin{aligned}\frac{\partial TR(w_t^s)}{\partial w_t^s} &= \frac{1}{2\beta}\frac{\partial E_t(w_t^s)}{\partial w_t^s}-\frac{1}{2\beta}\left\{\frac{\frac{\partial E_t(w_t^s)}{\partial w_t^s}u_t(w_t^s)-E_t(w_t^s)\frac{\partial u_t(w_t^s)}{\partial w_t^s}}{[u_t(w_t^s)]^2}\right\}+\\ &\quad \frac{x}{2\beta}\left\{\frac{\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s}u_t(w_t^s)-\Gamma_t(w_t^s)\frac{\partial u_t(w_t^s)}{\partial w_t^s}}{[u_t(w_t^s)]^2}\right\}\end{aligned} \tag{D18}$$

Rewriting D18 we have that :

$$\begin{aligned}&= \frac{\partial E_t(w_t^s)}{\partial w_t^s}\left[\frac{1}{2\beta}-\frac{1}{2\beta u_t(w_t^s)}\right]+\frac{\partial u_t(w_t^s)}{\partial w_t^s}\left[\frac{1}{2\beta}\frac{E_t(w_t^s)}{[u_t(w_t^s)]^2}-\frac{x}{2\beta}\frac{\Gamma_t(w_t^s)}{[u_t(w_t^s)]^2}\right]\\ &\quad +\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s}\frac{x}{2\beta}\frac{1}{u_t(w_t^s)}\end{aligned} \tag{D19}$$

We know that $u_t(\gamma_t^u(w_t))=\eta_0(\gamma_t^u)^a$; taking the derivative with respect to w_t^s results $\frac{\partial u_t(\gamma_t^u(w_t))}{\partial w_t^s}=\frac{\partial u_t}{\partial \gamma_t^u}\frac{\partial \gamma_t^u(w_t^s)}{\partial w_t^s}\Longrightarrow a\eta_0(\gamma_t^u)^{a-1}\frac{\partial \gamma_t^u}{\partial w_t^s}$. The sign of $\frac{\partial u_t(\gamma_t^u(w_t))}{\partial w_t^s}$ is negative since

$\frac{\partial \gamma_t^u}{\partial w_t^s} < 0$. From D19, the first two terms in the brackets are positive while both $\frac{\partial E_t(w_t^s)}{\partial w_t^s}$ and $\frac{\partial u_t(w_t^s)}{\partial w_t^s}$ are negative. The last term in D19 is positive as $\frac{\partial \Gamma_t(w_t^s)}{\partial w_t^s} > 0$. So the sign of $\frac{\partial TR(w_t^s)}{\partial w_t^s}$ depends on which of the two dominates. Similarly, an increase in wages has an ambiguous effect on transfer, to see this we write down the transfer Λ_t^e in case of exemptions as follows:

$$\Lambda_t^e = (\tau_t - \beta\tau_t^2)E_t(w_t^s) \tag{D20}$$

Rewriting (D20) in terms of tax revenue and collection costs, we have that

$$\Lambda_t^e = (1 - \beta\tau_t)TR(w_t^s) \tag{D21}$$

By substituting the equilibrium tax rate (5.18) into the term in the bracket, we obtain an expression for transfer in terms of tax revenue and variables of interest

$$\Lambda_t^e = (1 - \beta(\frac{(u_t(w_t^s) - 1)E_t(w_t^s) + x\Gamma_t(w_t^s)}{2\beta E(w_t^s)u_t(w_t^s)}))TR(w_t^s)$$

Rearranging and simplifying yields

$$\Lambda_t^e = \left(\frac{1}{2} + \frac{1}{u_t(w_t^s)} - \frac{x\Gamma_t(w_t^s)}{2E_t(w_t^s)_t u_t(w_t^s)}\right) TR(w_t^s) \tag{D22}$$

Differentiating $(D22)$ with respect to w_t^s and using the product rule we have that:

$$\begin{aligned} \frac{\partial \Lambda_t^e}{\partial w_s^t} &= \frac{\partial TR_t^e(w_t^s)}{\partial w_t^s}(1 - \beta\tau_t) + TR_t^e(- \frac{1}{[u_t(w_t^s)]^2}\frac{\partial u_t(w_t^s)}{\partial w_t^s} \\ &\quad -x\left\{\frac{\frac{\partial \Gamma_t}{\partial w_t^s}E_t(w_t^s)u_t(w_t^s) + x\Gamma_t(w_t^s)\frac{\partial E(w_t^s)}{\partial w_t^s} + x\Gamma_t(w_t^s)\frac{\partial u_t(w_t^s)}{\partial w_t^s}}{2\left[E_t(w_t^s)u_t(w_t^s)\right]^2}\right\}) \end{aligned} \tag{D23}$$

From D19 and D23, an increase in wage gap has an ambiguous effect in total transfer.

Proof of Proposition 5.3 (v).

Notice that this is not the case when there is no exemption, however. An increase in the wages unambiguously increases the tax base. To see this differentiate the tax base B_t with respect to w_t^s. Rewriting equation B_t in terms of wages yields

$$\frac{\partial B_t(w_t^s)}{\partial w_t^s} = \frac{d}{dw_t^s}\left\{\int_{h_{t-1}}^{\bar{b}_{t-1}} \left[(b_{t-1} - h_{t-1})(1 + r) + w_t^s\right] f(b_i)db_i\right\} \tag{D24}$$

Taking the derivative with respect to w_t^s and integrating $(D24)$ lead to the following results

$$\frac{\partial B_t(w_t^s)}{\partial w_t^s} = \frac{(\bar{b}_{t-1} - h_{t-1})}{\bar{b}_{t-1} - \underline{b}_{t-1}} > 0 \tag{D25}$$

From (5.16) it immediately follows that an increase in taxable income will increase lobby efforts by the unskilled i.e. $\frac{\partial \gamma_t^u}{\partial w_t^s} > 0$. Rewriting 5.16, we have that

$$\gamma_t(w_t^s) = (\frac{a}{2\beta\eta^2}\frac{B_t(w_t^s)}{N_t^u w_t^u})^{\frac{1}{2a+1}} \tag{D26}$$

Taking the derivative with respect to w_t^s, yields

$$\frac{\partial \gamma_t(w_t^s)}{\partial w_t^s} = \Omega \frac{\partial B_t(w_t^s)}{\partial w_t^s} \tag{D27}$$

where we have suppressed the constants $\frac{1}{2a+1}(\frac{a}{2\beta\eta^2}\frac{B_t(w_t^s)}{N_t^u w_t^u})^{\frac{-2a}{2a+1}}$ to Ω , and from D25 it follows that $\frac{\partial \gamma_t(w_t^s)}{\partial w_t^s} > 0$. Similarly it can be shown that the tax revenue will indeed increase

$$TR_t^{ne}(w_t^s) = \tau_t \left[(u(\gamma_t(w_t^s)))\right](B_t(w_t^s)) \tag{D28}$$

Differentiating D27 with respect to (w_t^s) and using the product rule yields:

$$\frac{\partial TR_t^{ne}(w_t^s)}{\partial(w_t^s)} = \left[\frac{\partial \tau_t}{\partial u_t}\frac{\partial u_t}{\partial \gamma_t(w_t^s)}\frac{\partial \gamma_t(w_t^s)}{\partial w_t^s}\right] B_t(w_t^s) + \tau_t \frac{\partial B_t}{\partial w_t^s} \tag{D29}$$

From the fact that $\frac{\partial \tau_t}{\partial u_t} > 0, \frac{\partial u_t}{\partial \gamma_t(w_t^s)} > 0, \frac{\partial \gamma_t(w_t^s)}{\partial w_t^s} > 0$, follows that $\frac{\partial \tau_t}{\partial w_t^s} > 0$, and hence, $\frac{\partial TR_t^{ne}(w_t^s)}{\partial(w_t^s)} > 0$. Next we consider, the effect on transfer

$$\Lambda_t^{ne}(w_t^s) = \left(\tau_t(w_t^s) - \beta\tau_t^2(w_t^s)\right) B_t(w_t^s) \tag{D30}$$

Differentiating $\Lambda_t^{ne}(w_t^s)$ with respect to (w_t^s) and using the product rule yields:

$$\frac{\Lambda_t^{ne}(w_t^s)}{\partial(w_t^s)} = (1 - 2\beta\tau_t) B_t(w_t^s)\frac{\partial \tau_t(w_t^s)}{\partial(w_t^s)} + \frac{\partial B_t}{\partial w_t^s}\left(\tau_t(w_t^s) - \beta\tau_t^2(w_t^s)\right) \tag{D31}$$

Given that both $\frac{\partial \tau_t(w_t^s)}{\partial(w_t^s)}$ and $\frac{\partial B_t}{\partial w_t^s}$ have a positive sign, it follows that $\frac{\Lambda_t^{ne}(w_t^s)}{\partial(w_t^s)} > 0$.

Appendix E: Proof of Proposition 5.4

From equation (4) we have that:

$$g_A = \theta^s S \left(\frac{\theta^s}{\theta^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{S}{U}\right)^{\frac{\phi-1}{1+\pi-\phi}} \tag{E1}$$

Rewriting $(E1)$ and letting $\delta = \frac{\pi}{1+\pi-\phi}$ and $1-\delta = \frac{1-\phi}{1+\pi-\phi}$ we find:

$$g_A = \theta^s \left(\frac{\theta^s}{\theta^u}\right)^{\delta-1} (N^s)^{\delta} \left((N-N^s)\, l^u\right)^{1-\delta} \tag{E2}$$

The effect of an increase in the supply of skilled people N^son growth is determined by partially differentiating the above function w.r.t. N^s and applying the product rule, which gives the following relation:

$$\frac{\partial g_A}{\partial N^s} = \left[\theta^s \left(\frac{\theta^s}{\theta^u}\right)^{\delta-1}\right] \left[\frac{N^s}{(N-N^s)\, l^u}\right]^{\delta} l^u \left[\delta \frac{(N-N^s)}{N^s} - (1-\delta)\right] \tag{E3}$$

The sign $\frac{\partial g_A}{\partial N^s}$ is positive if and only if the last term in RHS of equation E3 is positive. This requires $\delta N > N^s$.

Appendix F: Deriving the relationship between Tax rates and Growth rates.

Taking the first order condition of (8) and solving for γ_t^a, we have that:

$$\gamma_t^a = \frac{(1-2\beta\tau) B_t \eta a}{\gamma_t w_t^u 2\beta N^u \eta} \tag{F1}$$

From the equilibrium tax rate of equation (14):

$$\gamma_t^a = \frac{1}{\eta(1-2\beta\tau)} \tag{F2}$$

Solving γ_t^u from F1 and F2 we have that:

$$\gamma_t^u = \frac{a(1-2\beta\tau)^2 \bar{B}_t}{2\beta w_t^u} \frac{N^s}{N^u} \tag{F3}$$

Substituting γ_t^u, in the steady state equation gives:

$$g_A = \theta^s N^s \left(\frac{\theta^s}{\theta^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{N^s}{N^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{1}{1-(1-2\beta\tau^2)\,\Psi}\right)^{\frac{\phi-1}{1+\pi-\phi}} \tag{F4}$$

where $\Psi = \frac{a}{2\beta w_t^u}\frac{N^s}{N^u}\bar{B}_t$. If Ψ is taken to be some constant equation F4 says that the relation between g_A and τ is non-monotonic. A growth maximizing tax rate exists and can be shown by setting $\frac{\partial g}{\partial \tau} = 0$ and checking $\frac{\partial^2 g}{\partial \tau^2} < 0$. Similarly, when there is exemption it can be shown that in equilibrium γ_t^u can be written as follows:

$$\gamma_t^u = \frac{a\,(1-2\beta\tau_t)^2\,\bar{E}_t}{2\beta w_t^u}\frac{N_t^s}{N_t^u} \tag{F5}$$

Substituting F5 in the steady state will result

$$g_A = \theta^s N^s \left(\frac{\theta^s}{\theta^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{N^s}{N^u}\right)^{\frac{\phi-1}{1+\pi-\phi}} \left(\frac{1}{1-(1-2\beta\tau^2)\,\Pi}\right)^{\frac{\phi-1}{1+\pi-\phi}} \tag{F6}$$

where $\Pi = \frac{a}{2\beta w_t^u}\frac{N^s}{N^u}\bar{E}_t$.

Part III An Empirical Analysis

Chapter 6

Perceived Inequality counts more than Inequality *per se*

6.1 Introduction

As discussed in the introduction part of the thesis, neither the theoretical literatures nor the empirical findings establish unambiguous results. The failure to provide consistent empirical results to the question as to how inequality affects growth is attributed to several factors viz. the sensitivity of the results to the time coverage under study, model specification, measurement error and heterogeneity in comparability of data.[1] For example, it seems that regressing 20 or more, 10 and 5 years averages of growth rates on inequality indicators yields negative, neutral and positive effects on economies' growth rates respectively. Another "excuse" given in the literature is the difficulty of controlling for country-specific effects and incomparability of data (Atkinson and Brandolini; 2001). In order to overcome this problem, recent research has focused on country-specific studies to have less bias via gaining consistent and comparable data. These exercises, however, do not result in having a consistent relationship - whether negative or positive - between

[1] Barro (2000) also noted that it is difficult to find a consistent relation between the effect of inequality on growth rates, as theoretical predictions are washing-out each other.

levels of inequality and subsequent rates of growth.[2] This means, there is no strong law or at least no straight-forward relationship between inequality and growth.

Whatever the possible explanations given for the observed inconclusive empirical results, the tolerance displayed by different societies to the same measured amount of inequality could also be different, depending for example, on its source. In other words, inequality may mean different things to different people since its creation relies on several factors.

For example, when inequality reflects the outcome of the market process, it is probably perceived as fair by citizens, as they feel that they "deserve" it. For those who interpret inequality as a sign of opportunity or reward of productivity, it is difficult to accept that there are negative effects. If, however, inequality has emerged due to actions that are perceived as unfair, it is likely that people will feel others are getting something they don't deserve. For those who see inequality as a reflection of persistent disadvantage for a particular section of society, it is hard to see positive elements. Therefore the concept of "perceived inequality" we adopt is similar to Alesina and Angeletos (2005), based upon the distinction between two types of inequality: "justifiable" inequality induced by variation in talent and effort, and "unjustifiable" inequality induced by variation in corruption and rent seeking.

Given the fundamental differences of sources of inequality, could it be the case that while income inequality may not directly affect an economy's aggregate growth potential, other things being equal, the way it is generated and how members of a society react to it, might have a fundamental effect on growth rates?

Economists and statisticians usually arrange people or households in ascending order according to income or expenditures abstracting from the way it emerges. Surprisingly, however, no comprehensive analysis of perceived inequality exists, perhaps because of the difficulty in measuring it. A first step towards such an analysis was a recent discussion concerning the interaction of inequality and rule of law (Glaeser *et al.,* 2003). Glaeser *et al.*, (2003) run a bivariate regression between

[2]Even though in recent years, new and more reliable databases (Deininger and Squire 1996 and LIS 1998) have been collected and eventually used in empirical studies.

GDP growth and inequality and find that inequality is bad for growth, but only in countries with poor rule of law. This result is in line with the cross-country and panel data evidence which we provide below, which shows that inequality is harmful to growth, but only when corruption is high. An important issue that we address here is whether the same level of inequality could have different implications for economic performance in countries in which differences in the rule of law, expropriations etc. prevail.

We consider an empirical framework that incorporates the perception of individuals to the source of inequality, i.e. the perceived level of corruption in a country is used as a proxy as to how individuals perceive the generation of wealth. The main indicators for corruption used in this analysis are from Transparency International (TI), a non governmental organization located in Berlin, which issues the Corruption Perception Index (CPI). It combines information from several sources. This index is based not only on the locals but also on international surveys of business people and reflects their impressions and perceptions of the level of corruption within countries. It describes the level of perceived corruption in the public sector using a poll of political risk indexes. Corruption is indisputable where those in power use illegal means to enrich themselves; assuming that CPI raters used this same criterion, it becomes natural to think that the CPI's score could be used as a proxy as to how society perceives the generation of wealth i.e. fairly or unfairly generated. Figure 6.1 presents a simple bivariate scatter plot of wealth inequality and corruption.[3]

The question that we ask is whether a Gini of 48.10 for Malaysia in the early 1980s has the same implications to a comparable Gini 49.27 for Senegal? Could an inequality measure that places Israel and Kenya in the same basket (75.49 and 74.59, respectively, in 1980s) in growth regressions carry the same information? Results from chapter 2 clearly indicate that the answer is no. In an experimental setting, the results from chapter 2 show that if inequality is perceived as resulting

[3]We proxy for wealth inequality via land inequality. The data is from Food and Agriculture Organization (FAO) of the United Nations. For more See Appendix.

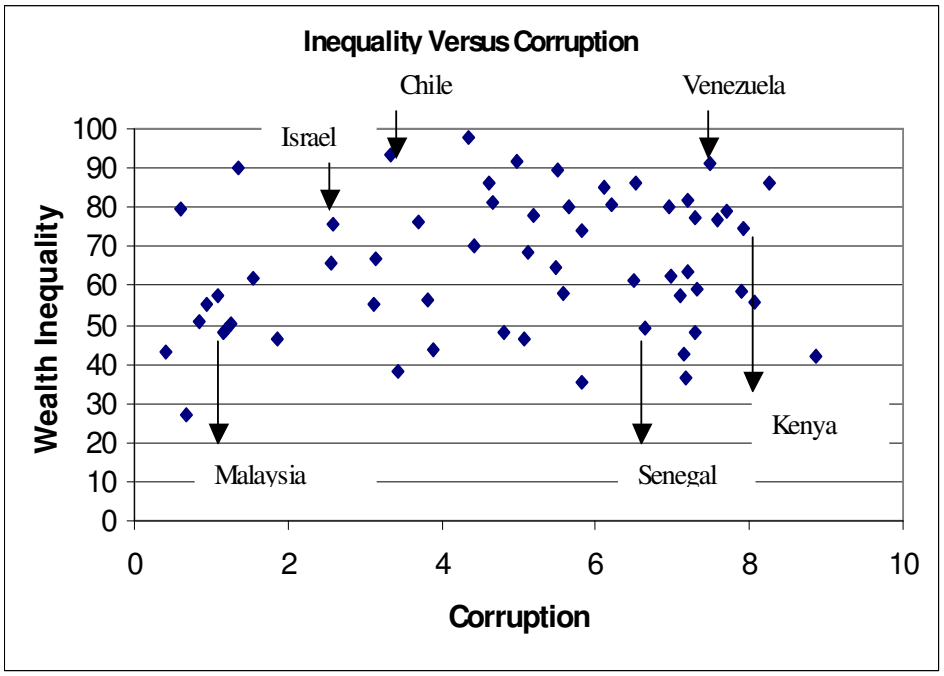


Figure 6.1: Inequality Versus Corruption

from a fair procedure, it will not affect cooperation and hence not affect growth, whereas if it is perceived as resulting from unfair actions on the part of a small group, it will hamper growth. If perceived level of inequality is important, countries with the same degree of inequality can pursue different growth rates as the origins of resource creation are heterogeneous. We hypothesize, *ceteris paribus*, that in countries like Kenya, Senegal and Venezuela growth can be expected to be lower given the fact that they have a higher level of corruption when one compares them to Malaysia, Israel and Chile respectively.(See Figure 6.1.)

In order to test our hypothesis, we run several regressions using both Ordinary Least Squares (OLS) and panel data estimates. Contrary to previous findings on the inequality-growth regressions, this chapter delivers a consistent message i.e. income inequality alone does not have a significant impact on growth; rather its interaction with corruption is negative and statistically significant. In other words, the negative effect of inequality, if any, operates only in highly corrupt

countries suggesting that it only matters when its generation is perceived as unfair by members of a society.

We proceed in the following fashion. We first attempt in section 6.2 to understand what causes the contemporary increase in the recent measured inequality. In section 6.3, we present the data and estimation methods. In section 6.4 we test empirically the prediction that perceived inequality could be a more important variable than inequality per se. The last section concludes.

6.2 Is income inequality really a problem?

From Chapter 2, we have seen that the ability of people in a society to cooperate for the common good, assumed to have a link to economic growth, does not depend on the degree of inequality. Chapter 2 also tested the effect of inequality on the propensity to cooperate in a design where the degree of distribution is endogenous, with varying degrees of inequality. In one treatment, a self-interested first mover makes the initial choice; in the second treatment, a random draw causes the first choice. This study finds strong support for the role of intention in that when high inequality is set by the rich, the poor tend to cooperate less (negative reciprocity) than otherwise. In a related experiment, Charness (2004) conducts an experimental labor market in which the attribution for an assigned wage serves as the treatment variable. When wages are generated by a random process, workers tend to exert costly efforts. However, situations are different when lower wages are set by self interested firms. In general, workers feel that when wages are set unfairly, they will less likely be loyal to the firm when choosing efforts. In short, experimental evidence seems to suggest a reciprocal behavior i.e. rewarding nice behavior and punishing bad behavior.

To extrapolate the experimental findings to societies as a whole, one might expect that the same kind of relationship between inequality and growth shows up in comparing countries. In other words, individual members of a society behave in the same way towards 'unfair' institutions as towards 'unfair' individuals.

Should we care about the rise in inequality that emerged under fair or unfair

institutions? What forces contribute to the recent rise in inequality? Inequality is generally determined by the interplay of various factors: the main ones are broad economic changes and the role of governments (Tanzi, 1998). The shape of income distribution a country ends up with, indeed, is determined by market outcomes and government interventions.

There is now a fast growing literature that discusses the impact of globalization on the relative wages of skilled and unskilled workers and on income distribution in general. The increase in inequality has been the results of several things i.e. increases in productivity (Kruger 1994; Acemoglu, 1999), entrepreneurial successes (Aghion *et al.* 1999; Snower 1999) and increased work by high-wage individuals (Costa, 1998).[4] Each of these sources of higher incomes adds income or wealth without reducing the wealth of others. The question that arises, of course, is whether it is wrong to see an increase in the well-being of the well-off or an increase in inequality that results from market outcomes? And how do individuals perceive this? Recent evidence indicate individuals do not give a negative weight to others well-being if the reward is based on ability. The European Value Surveys in 36 countries asked respondents, "Would you say that it is fair if quicker secretaries are paid higher than others?" The mean response averaging across all countries, was that 83% of respondents thought it is fair.

How about if inequality that results from unfair actions of some members of society? Probably, people might consider it as unfair. In highly corrupt countries, the misuse of public power for private benefits is observed, signalling a degrade in the perception towards the fairness of resource generation.[5] For a given level of inequality, differences in the perceived level of corruption i.e. different values of a

[4]Dora Costa (1998) reported that higher-paid empolyees tend to work longer hours, a reversal of the earlier tendency of those with lower wages to work longer hours. This has resulted in an increase in a measured inequality.

[5]We are aware of the fact that corruption has different meanings in different societies. One person's bribe is another person's gift (Rose-Ackerman, 2001). We consider here the presence of extreme forms of corruption that arise from governments. If society perceives corruption as an abuse of obligations of fairness by corrupt officials for their private gain, it signals betrayal of public trust.

corruption score will result in different growth patterns.

6.3 Data and Model Specification

An empirical test of this hypothesis that predicts income inequality should not affect growth rates, will be investigated in section 6.5 but first the data and model specification will be presented.

6.3.1 Data Description

Tables 6.1 and 6.2 report summary statistics of the variables used in this chapter. Our study attempts to identify the impact of inequality on growth rates using panel data of 53 countries from the period 1980-1999. Earlier data and wider coverage are not considered, due to the incompleteness of data on corruption. The main indicators for corruption used in this analysis are Transparency International (TI)'s Corruption Perception Index (CPI). For a robustness check we also used another source of corruption data which is available from the Political Risk Service (PRS)'s ICRG (International Country Risk Guide).

In this study, we will use two measures of inequality i.e. land and income Gini, though obtaining accurate data for income distribution is challenging. We used income inequality compiled by the Texas Inequality Project which is available for quite a long period of time and convenient for panel data. We do not use data on inequality from Deininger and Squire (1996) as observations for mid-1990s are hardly available.[6]

We include control variables that are widely used in cross-country studies of growth, including initial GDP per capita at the beginning of the period (to check

[6]Moreover, the problems concern the fact that the Gini coefficients compiled by Deininger and Squire (1996) for different countries have not all been calculated using the same methods. For example, some are based on gross income, while others use net (disposable) income. In addition, although the data set is largely based on the household as the choice of reference unit, some measurements are based at the individual level. Another difference between the country time series of Gini coefficients is that some use expenditure whereas others use income.

for the convergence hypothesis), the average ratio of investment to GDP over the period, a measure of human capital investment, inflation, openness, government consumption ratios, political right index and both time and continental dummies. For more sources of data and description of variables see the Appendix.

6.3.2 Model Specification

In this empirical study, we will analyze inequality-growth relationships in the short, medium and long run, meaning that the dependent variable (the growth rate of GDP per capita) is averaged over 5 years forward, over 10 years forward and over 20 years forward, respectively. But first we will present the econometric model. Almost all empirical studies on the relationship between economic growth and inequality base their regression on reduced form estimations of the determinants of growth in a cross section of countries which look like

$$g_i = \mathbf{X}_i^{'}\boldsymbol{\beta} + \boldsymbol{\varepsilon}_i \tag{6.1}$$

where g_i is the average growth rate of GDP per capita over a certain time period, $\mathbf{X}_i$ is a vector of determinant of growth rates, $\boldsymbol{\beta}$ is a vector of coefficients to be estimated and $\boldsymbol{\varepsilon}_i$ is an error term. Most of the models of inequality and growth up to 1996 use a reduced form estimation where they add the income distribution variable as one of more explanatory variables in a standard economic growth regression. The problems that plague cross-sectional growth regressions have recently received a great deal of attention (Jonathan Temple, 1999) namely omitted-variable bias due to unobserved heterogeneity.

Here we address these issues by using panel data estimators which permits to mitigate the confounding impact of omitted variables on the inequality-growth relationship by controlling for country-specific effects via the following specification.

$$g_{it} = \mathbf{X}_{it-1}^{'}\boldsymbol{\beta} + \eta_i + \delta_t + u_{it} \tag{6.2}$$

where i represents each country and $t = 1, 2, ...T$ (five-year time period) represents time; $\mathbf{X}_{it-1}^{'}$ now is a vector of lagged (for a five-year period) explanatory variables

that can vary over t and i; η_i is unobserved heterogeneity with variance σ_η^2 and δ_{t-1} are period dummies. It can be viewed as unobserved country characteristics e.g. due to technical inefficiency, that are constant over time and influence g_{it}; and u_{it} is an idiosyncratic error term with variance σ_u^2. With panel data the issue is whether to use a random effects or fixed effects estimation approach. Hausman's specification test will be used to identify whether the random effects assumption is satisfied or not. If the estimated coefficients generated by both random and fixed effects are statistically different, Hausman opts for the consistent fixed effects estimator as the assumption of the random effects are incorrect. In other words η_i and $\mathbf{X}'_{it-1}$ are correlated.

6.4 Empirical Results

We now turn to the baseline estimation. We have considered five variations viz. OLS five year panel regressions, OLS base line regressions medium and long term, the base line regressions with more countries and different measures of corruption, medium run panel estimates and short run panel estimates of the relationship between inequality and growth. As the Tables in the Appendix show, the regression coefficients of both inequality measures are not significant in almost all cases. Rather the interaction term between inequality and corruption is negative and statistically different from zero, suggesting that perceived inequality matters more than inequality *per se*. Our findings are consistent with the theoretical prediction established in Chapter 2, that income inequality is neutral to growth. The next subsections present the detailed results.

6.4.1 OLS Cross-Section Regressions

We start our analysis from OLS estimation and see whether the estimation results are sensitive to estimation methods. First, we report the pooled short run analysis and second we will display the results of medium run and long run growth analyses.

Short run pooled regressions

Table 6.3 and 6.4, the standard reduced form of the model, pool the data of average growth between 1980-84, 1985-1989, 1990-1995 and 1995-1999 as a dependent variable. The independent variables include log of initial GDP per capita for each period, corruption, the percentage of secondary enrollment in the population (initial human capital investment), inequality measures (income and land Gini) and their interaction with corruption, inflation, government consumption ratio, openness, regional dummies and political rights index. Table 6.3 shows a set of regressions for the estimated model.

Column 1 of Table 6.3 displays a simple regression which takes income inequality and the log of initial GDP per capita as regressors. Both explanatory variables are not only significant but also have the expected signs. Similar to many findings, the coefficient for log GDP per capita is significant and has the expected sign, showing that those countries with highest product in the previous period grew less, suggesting conditional convergence. Column (2) extends the model by including corruption as a regressor. The inclusion of corruption improves the fit of the model, leaving the signs and statistical significance of the two previous regressors unchanged. In column (3) we checked whether the results are sensitive to the inclusion of regional dummies. Indeed, while the fit of the model increased, similar to many findings in the literature (see e.g. Deininiger and Squire, 1998; Forbes, 2000) the significance of income Gini vanishes suggesting the existence of omitted variable bias. Moreover, similar to many cross-country regressions the regional dummy for African countries is now negative and statistically significant at 5% and also the dummy which represents Asian countries is positive and significant at 1%. Column (4) adds the interaction term between income Gini and corruption. The interaction term is significant and has the expected sign while the sign of both income Gini and corruption now change to positive and retain their significance. Finally, we find the corruption variable has an unexpected sign though its net effect is negative.[7]

[7]Higher corruptibility clearly correlates with lower growth rates. A unit increase in corruption

In column 5 of Table 6.3, we include policy variables as control regressors. The measure of government consumption as a proportion of GDP, which is used to proxy the effect of government fiscal policy and intervention in the economy, is negatively affecting growth rates similar to the findings of Barro (2000). Moreover, the education variable which captures countries human capital investment is positive and statistically different from zero suggesting that policies to expand education will have positive impact on countries growth rates. Contrary to the findings of Easterly *et al* (1993) , we find openness to positively affect growth rates growth, although it is statistically insignificant. The inflation rate, used to proxy the effects of exchange rate and monetary policy, has an unexpected sign and is not statistically significant. With the political rights index in the model, corruption is no longer a significant coefficient, even though the signs remains the same.

The last specification combines land Gini and its interaction with corruption. Moreover, column (6) drops the political rights index variable as it didn't improve the fit of the model. The overall fit of the model now improves. Higher corruptibility clearly correlates with lower growth rates. Not only the interaction term between income inequality and corruption is significant as shown in specification (6) but also the interaction term between land Gini and corruption is significant. Both the inequality and corruption measures are also significant though they have an unexpected positive sign. A unit increase in corruption decreases growth (at the mean) by 0.25 units ($= 2.165 - 0.042$ x $39.373) - 0.012(63.828)$. With respect to income inequality, the (significant) coefficient implies that a unit increase in inequality (evaluated at sample means) causes a decline in growth by 0.013 units ($= 0.183 - 0.042$ x 4.561).

Results are only slightly different for policy variables; in particular the variable "openness" changes its sign, although the coefficient is not statistically different from zero. The significance of log of initial GDP per capita is unaltered, suggesting that there is a significant validation of the convergence hypothesis. A one unit

decreases growth (at the mean) by 0.53 units ($= 0.88 - 0.031$ x 39.187). With respect to inequality, the (significant) coefficient implies that a unit increase in inequality (evaulated at sample means) causes a decline in growth by 2% ($= 0.121 - 0.031$ x 4.561).

increase in log of initial GDP per capita produces an average decrease of 0.92 in growth. All the policy variables are of the expected sign and the variables that are statistically significant are the "education" variable and ratio of government consumption to GDP. Also a standard deviation increase in education (29.50) produces an average gain of (0.63) in growth. This means a 1 unit increase in enrollment ratio produces a $29.50/0.63 = 0.02$ units average increase growth. Similarly, a one unit increase in government ratio declines growth rates to about 0.088 units. Table 6.4 presents estimated results of a similar exercise with land inequality. The results remain basically the same. In particular, the interaction term between wealth inequality and corruption is highly significant.

Medium run and long run regressions

Another issue involved in the inequality - growth regressions is whether one averages growth over a decade or longer periods. Most theoretical models are built on inter generational growth patterns; therefore the long run economic growth is usually investigated. Most of the previous studies analyze the effects of inequality on growth over a period of 20-25 years, starting from 1960. Long-run data are particularly useful for thinking about why countries differ in their level of income today, because much of the variation in current income has its roots in the last say 100 years of economic growth. As we have seen so far, our analysis with respect to growth started in 1980 due to mainly the unavailability of data for corruption for earlier periods.

To check the sensitivity of our results with respect to the length of the time period, we performed several additional regressions. Columns (1) and (2) of Table 6.5, for example, average the dependent variable over a 10 year period securing a two decade panel. While some observations are lost, most of the previous results are retained. From column 1, we see that a unit increase in corruption decreases growth (at the mean) by 0.13 units ($= 2.116 - 0.038$ x $(38.311) - 0.013$ x (63.471)). With respect to land inequality, the (significant) coefficient implies that a unit increase in inequality (evaluated at sample means) causes a decline in growth by

0.03 (= 0.029 − 0.013 x 4.701). Results remain if we see on column (2) of Table 6.5 that explains 49.08% of the variation in economic growth, which is a good fit. In particular variables like loggdp, Income*corr, land*corr, govt and openness variables are significant and have expected signs. Inflation is significant though with unexpected sign while income and land Gini are not significant any more and have unexpected sign. The education and the political index variable are not only insignificant but also have unexpected sign. The dummy for income is negative and significant, suggesting that growth tends to be lower in low-income countries on average.[8]

In column (3) to (4) of Table 6.5, we test the long run relationship between inequality and growth by considering an average of a 20 year period.[9] Not only the interaction term between income inequality and corruption is significant as shown in specification (3) and (4) but also the interaction term between wealth inequality and corruption is significant at conventional levels. From the results one could deduce that controlling for the perceived inequality, both inequality measures do not seem to matter for growth. That is to say both inequality measures lose their significance after the inclusion of the interaction term suggesting that income inequality does not have an impact on economic growth. In contrast, the interaction term between corruption and inequality is highly significant. From column (3) one can see that a unit increase in corruption decreases growth (at the mean) by 0.38 units (= 2.596 − 0.054 x 37.260) − 0.015 x (64.252). The education variable not only loses its significance but also has unexpected sign, which is common in the literature dealing with cross section studies. The other variable which has unexpected sign is the inflation variable.

The long run and medium run results reveal that the significance of the interaction term is robust and highly significant across different time dimensions i.e. whether growth is averaged over 10 years or 20 year periods. We also checked

[8] Not reported here, I also checked regional dummies and legal dummies. Both dummy measures do not change much of the results.

[9] The data for the estimation of long run growth rates diminishes from 53 to 37 countries due to the incompleteness of data.

whether the results summarized in Table 6.5 are not driven by a few observations. We increased the number of countries from 37 to 83 using different measures of corruption i.e. Countries Risk analysis and data of corruption used by Persson and *et al.* (2004). Then we re-estimated specification (1) and (2) in Table 6.6, the results of which are summarized in Table 4.7. Columns (1) to (3) use data from Persson and *et al.* (2004) and the last column (4) uses data compiled by International Country Risk Guide (ICRG). The significance levels are only slightly affected, while none of the earlier conclusions are challenged.

6.4.2 Panel Data Regressions

In pooled OLS estimator, η_i is assumed to be zero, and μ_i,$_t$ are i.i.d. and independent of all explanatory variables. In other words, we assume that the intercepts do not vary across countries (homogeneous), that each observation is cross sectional and time-series independent and that all explanatory variables are strictly exogenous. Clearly, these assumptions are restrictive: e.g. if there are country-specific effects on growth, the homogeneity assumption will be violated. After relaxing the assumptions, can we replicate the results with panel estimates?

Estimates vary significantly, based on which technique is utilized (fixed or random effects), so it is necessary to test the validity of the assumptions underlying each method. Note that in the fixed effect approach, $\eta_i's$ are treated as model parameters and are hence estimated. The random effect model treats $\eta_i's$ as the result of a random draw from some distribution (e.g. normal). For growth models the use of a fixed effects model is recommended, as country specific issues matter though more efficient estimates are obtained with random effects than fixed-effect models (cf. Verbeek, 2000). Still, the consistency criterion of such a random-effect approach requires $\eta_i's$ to be un correlated with explanatory variables of the model, i.e. the $X's$ (Baltagi, 2001). Since the Hausman specification test points out that in almost all specifications this assumption is violated as one would expect with growth models, we report the results from the fixed-effect approach.[10]

[10]In both panel estimates the subset of coefficients that are estimated by the fixed effects

Before we report the results of panel estimates of the short run period (five year averages), columns (1) to (3) in Table 6.7 shows estimates of a ten-year panel using fixed effects estimators. This exercise is done to check whether results are sensitive to period length. We introduce both time dummies and investment GDP ratio to the panel estimation following Forbes (2000) and Squire & Ontillo (2004) respectively. The time varying regressors used in the basic growth equation includes initial log GDP per capita for each period, share of gross domestic investment to GDP, corruption, education, inflation, government, openness and also time dummies. To control for endogeneity, initial values of the beginning of the period are used.[11] The coefficient on inequality remains insignificant while the coefficient of the interaction term between inequality and corruption still survives i.e. it is negative and statistically significant at 5%.[12] Similar to the Squire and Ontillo (2004) results we find that the investment/GDP ratio is positively related to the growth rates and is statistically significant. Almost all the policy variables are of the expected sign and the only variable that is statistically different from zero is the government consumption ratio, while the inflation variable has the unexpected sign and is statistically significant.

The next question that we address is whether the inequality variable becomes positive when a 5-year panel is estimated. Columns (4) to (6) of Table 6.7 shows the panel estimates of short run growth regressions. We concentrate our interpretation on the last column of Table 6.7 that shows the results that combine specification (1) which relies on income inequality and (2) that uses land inequality. This nested model explains 48.24% of the variation in economic growth, which is a good fit,

---

estimator and the random effects estimators are significantly different suggesting that η_i and $\mathbf{X}_{it}^{'}$ are correlated. The null Hypothesis that there is no systematic difference in coefficients is rejected as p value is less than 5%, Hausman is in favour of the fixed effects estimator. (See Table 6.7)

[11] Forbes' panel data set, constructed from Deininger and Squire, consists of six five year intervals, from 1961-65 through 1986-90. In each interval she chooses the data point closest to the end point of the interval, instead we choose an initial period to minimize endogeinity problems as we are using fixed and random effects estimators.

[12] Higher corruptibility clearly correlates with lower growth rates. A unit increase in corruption decreases growth (at the mean) by 0.36 units ($= 1.816 - 0.047$ x 38.635).

compared to other regressions. The interaction term between income inequality and corruption is negative and significant as shown in specification (6). Contrary to the results of Forbes (2000) and Zou and Li (1998), the results in Table 6.7 suggest that income inequality does not have any impact on economic growth. Similar to many findings, the coefficient for log GDP per capita is significant and has the expected sign showing conditional convergence. Similar to the results of Deininger and Olinto (2000) we can see that investment and education do have expected sign and are significant contributors to economic growth. Similar to the results of Li and Zou (1998), time specific dummy variables for (1985-1989), (1990-1994), (1995-1999) appear to be significant and increase over time. This result seems to suggest that economic growth has been relatively faster in recent years. The measure of government consumption as a proportion of GDP, which is used to proxy the effect of government fiscal policy and intervention in the economy, is negatively affecting growth rates similar to the findings of Barro (2000).

6.5 Conclusion

To date the relationship between inequality and growth is far from well understood. Even if empirical and theoretical results predict a negative or positive effect of inequality on growth, the significance and magnitude of the relationship still vary in different dimensions viz. the relationship is sensitive to the definition of inequality or the time coverage under study. This paper emphasizes the importance of perceived inequality that has been largely ignored by studies on inequality-growth relationships.

In reality, there are many sources of inequality viz. market generated inequality which is perceived as relatively fair and inequality generated via unfair means. This paper is an attempt to "deconstruct" the concept of inequality and in particular the idea that what often matters is not the degree of inequality *per se* but rather the way in which it is actually perceived by members of society. In general this insight has very powerful implications for the relationship between inequality and growth and in particular the tolerance displayed by different societies to the same

measured amount of inequality.

We analyze the importance of perceived inequality and find that the interaction term between corruption and inequality is negatively related to countries' subsequent growth rates. Using panel data estimates, this paper directly estimates how changes in inequality are correlated with changes in growth within a given country. Results suggest that both in the short and medium run, an increase in a country's level of income and/or an increase in wealth inequality does not have any relationship with subsequent growth rates. In fact our results suggest that the effect of income inequality is only operative in countries where institutions are weak i.e. in highly corrupted countries. The sensitivity analysis challenges the current belief that measures of inequality are negatively related to long run growth. Both long run and medium term OLS regressions suggest that while inequality measures do not have a significant relationship with growth rates, their interaction with corruption is negative and statistically significant, suggesting that perceived inequality matters more than inequality *per se*.

In our view, the results of this paper should be seen as corroborating the view that perceived inequality is an important element in explaining growth. Thus, an improvement in institutional setup that may result due to regime shifts accompanied with effective anti-corruption measures could mitigate the negative effect of inequality on growth.

Therefore, the estimates in this paper should be interpreted as suggesting that further careful analyses should be developed for the measurement of the perceived inequality. It would be desirable to construct an index measure of perceptions for several countries, to be used as additional explanatory variables within a regression analysis based on cross-country data and identify the possible channels for the effect of inequality on growth.

Appendix to Chapter 6

Table 6.1: Variables used for short, medium and long run OLS estimates

Variable	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
	Short run, N=151		Medium run, N=78		Long run, N=37	
Growth	1.895	2.593	1.942	1.626	1.896	1.446
Loggdp	3.89	0.412	3.877	0.412	3.852	0.407
IncomeGini	39.373	6.226	38.311	6.068	37.26	6.034
Corruption	4.656	2.663	4.700	2.741	4.61	2.689
Incomegini*corr	193.700	125.900	190.028	124.4	181.287	120.090
LandGini	63.828	16.867	63.472	16.840	64.252	16.931
Landgini*corr	300.939	189.751	305.046	196.351	305.712	203.429
Education	73.940	29.510	69.823	27.452	65.345	25.911
Inflation	134.10	999.651	91.577	422.620	24.308	28.539
Govt	16.620	6.170	16.829	6.498	16.670	6.013
Openness	59.47	31.810	58.455	31.035	58.569	29.596
Political Right	4.139	2.611	4.139	2.611	0.531	0.502
Africa	0.205	0.405	0.205	0.405	0.205	0.405
Asia	0.033	0.180	0.033	0.180	0.033	0.180
Middle east	0.099	0.300	0.099	0.300	0.099	0.300
Latin	0.205	0.405	0.205	0.405	0.205	0.405
European	0.293	0.457	0.293	0.457	0.293	0.457
North America	0.119	0.325	0.119	0.325	0.119	0.325

Table 6.2: Variables used for short and medium run panel regressions

Variable	Mean	Std. Dev.	Mean	Std. Dev.
	Medium run N=81		Short run N=158	
growth	1.831	1.721	1.821	2.335
Loggdp	3.852	0.425	3.870	0.428
Gdi	22.220	4.838	22.232	5.202
IncomeGini	38.635	6.240	39.649	6.374
Landgini	65.26	17.281	64.523	17.281
Corruption	4.786	2.714	4.753	2.675
Education	68.031	28.476	72.457	30.146
Inflation	88.440	414.933	129.665	977.427
Govt	16.661	6.450	16.427	6.141
Openness	58.039	30.557	60.424	36.513
Ingini*corr	195.028	125.114	199.075	127.414

Table 6.3: OLS Pooled Regressions (Data divided into 5 year panels)

Estimation	(1)	(2)	(3)	(4)	(5)	(6)
Constant	10.405	15.382	11.386	7.298	10.260	3.023
	(3.955)***	(3.995)***	(3.966)***	(3.799)*	(5.438)*	(5.510)
Loggdp	-0.937	-2.113	-1.897	-2.272	-2.982	-2.170
	(0.653)***	(0.742)***	(0.721)***	(0.729)***	(1.084)**	(1.151)**
IncomeGini	-0.124	-0.103	-0.035	0.121	0.133	0.183
	(0.042)***	(0.042)**	(0.044)	(0.076)**	(0.083)*	(0.084)**
Corruption		-0.276	-0.275	0.880	0.724	2.165
		(0.109)***	(0.115)**	(0.437)**	(0.083)***	(0.695)***
Asia			1.753	1.700	0.885	0.359
			(0.562)***	(0.553)***	(0.711)	(0.535)
Europe			0.648	0.723	0.458	0.226
			(0.520)	(0.504)	(0.689)	(0.452)
Latin			-0.421	-0.546	-0.800	-0.088
			(0.678)	(0.638)	(0.715)	(0.590)
Middle			0.267	-0.125	0.633	-0.622
			(0.769)	(0.787)	(0.959)	(0.821)
Africa			-2.239	-2.425	-2.575	-2.668
			(1.201)*	(1.227)**	(0.949)*	(0.827)**
Ingini*corr				-0.031	-0.028	-0.042
				(0.012)***	(0.013)*	(0.015)***
Education					0.030	0.021
					(0.012)**	(0.013)*
Inflation					0.0001	0.0001
					(0.0002)	(0.0001)
Openness					-0.0004	0.007
					(0.005)	(0.006)
Govt					-0.136	-0.088
					(0.047)***	(0.045)*
Political					-0.019	
					(0.138)	
Landgini						0.022
						(0.022)
Land*Corr						-0.012
						(0.005)***
#obser.	179	179	179	179	157	151
R^2	0.0567	0.0993	0.2061	0.2324	0.2229	0.2812

"*',** , and *** denote 10%, 5% and 1% significance level respectively. Robust Std. Err. in brackets.

Table 6.4: OLS Pooled Regressions (Data divided into 5 year panels)

Estimation	(1)	(2)	(3)	(4)	(5)
Constant	4.663	7.075	6.797	4.412	6.233
	(1.434)***	(2.664)***	(2.947)***	(3.148)	(4.101)***
Loggdp	-0.092	-0.627	-0.897	-0.821	-1.486
	(0.321)	(0.611)***	(0.686)*	(0.675)	(0.941)
Landgini	-0.038	-0.037	-0.020	0.013	-0.030
	(0.010)***	(0.011)**	(0.011)	(0.021)	(0.021)
Corruption		-0.100	-0.117	0.401	0.463
		(0.107)	(0.112)	(0.320)	(0.346)
Asia			1.238	0.924	0.686
			(0.503)***	(0.489)	(0.519)
Europe			0.559	0.703	0.438
			(0.500)	(0.438)	(0.431)
Latin			-0.427	-0.148	-0.054
			(0.630)	(0.648)	(0.601)
Middle			0.142	-0.125	-0.083
			(0.741)	(0.723)	(0.802)
Africa			-0.958	-1.032	-0.990
			(0.856)	(0.843)	(1.105)
Landgini*corr				-0.008	-0.011
				(0.002)***	(0.004)***
Education					0.017
					(0.011)
Inflation					−0.00001
					(0.00001)
Openness					0.001
					(0.005)
Govt					-0.094
					(0.042)***
Political					-0.068
					(0.117)
#obser.	182	182	182	168	168
R^2	0.091	0.081	0.123	0.162	0.188

"*',**, and *** denote 10%, 5% and 1% significance level respectively.Numbers in brackets denote robust standard errors.

Table 6.5: OLS estimates of Meduim run and Long Run Growth rates

Estimation	(1)	(2)	(3)	(4)
Constant	9.514	13.200	18.451	22.47
	(4.843)***	(4.833)***	(6.590)***	(6.085)***
Loggdp	-2.502	-3.051	-4.109	-4.495
	(1.125)**	(1.156)***	(1.402)***	(1.322)***
IncomeGini	0.089	0.105	0.075	0.064
	(0.076)	(0.069)	(0.080)	(0.076)
Corruption	2.116	1.894	2.596	2.063
	(0.497)***	(0.464)***	(0.708)***	(0.708)***
Landgini	0.029	0.019	0.018	0.007
	(0.014)**	(0.014)	(0.015)	(0.012)
Ingini*corr	-0.038	-0.038	-0.054	-0.048
	(0.012)***	(0.011)***	(0.015)***	(0.013)***
Land*corr	-0.0125	-0.012	-0.015	-0.018
	(0.003)***	(0.003)***	(0.004)***	(0.004)***
Education	0.009	-0.001	0.0004	-0.004
	(0.017)	(0.014)	(0.024)	(0.014)
Inflation	0.001	0.001	0.012	0.013
	(0.0002)***	(0.0002)***	(0.010)	(0.008)
Govt	-0.117	-0.141	-0.107	-0.142
	(0.040)***	(0.036)***	(0.058)*	(0.045)***
Openness	0.009	0.011	-0.002	0.002
	(0.006)	(0.006)*	(0.006)	(0.006)
Political	-0.110	0.012	-0.206	-0.084
	(0.109)	(0.095)	(0.138)	(0.129)**
Incomedum		-1.859		-1.925
		(0.542)***		(0.618)***
#obser.	78	78	37	37
R^2	0.4334	0.4908	0.561	0.652

"*',**, and *** denote 10%,5% and 1% significance level respectively. Numbers in brackets are robust standard errors. Column 1 and 2 are pooled OLS estimates (data divided into 10 year periods).(Column 3 to 4, are long run OLS estimates. Growth is averaged over 20 years).

Table 6.6: Sensitivity analyisis : Medium run data , estimation obtained using OLS over 10 years averages

	(1)	(2)	(3)	(4)
Constant	9.383	0.060	7.535	0.533
	(5.020)*	(4.112)	(4.081)*	(5.907)
Loggdp	-2.058	-0.864	-1.423	-0.357
	(0.980)**	(0.882)	(0.824)*	(1.196)
Incomegini	0.127		0.085	0.124
	(0.085)		(0.063)	(0.097)
Corruption	0.761	0.300	1.161	1.445
	(0.517)	(0.269)	(0.450)**	(0.889)**
Ingini*corr	-0.034		-0.023	-0.042
	(0.014)**		(0.011)**	(0.023)**
Govt	0.164	-0.131	-0.140	-0.110
	(0.038)***	(0.038)***	(0.030)***	(0.040)***
Education	0.005	0.012	-0.002	0.013
	(0.015)	(0.012)	(0.012)	(0.016)
Openness	0.011	0.011	0.010	0.011
	(0.006)*	(0.004)***	(0.004)**	(0.004)***
Inflation	0.0001	0.0002	0.0003	0.0001
	(0.0002)	(0.0001)	(0.0001)**	(0.0001)
LandGini		0.023	0.016	
		(0.019)	(0.020)	
Land*Corr		-0.010	-0.012	
		(0.003)***	(0.001)***	
#obser.	70	59	57	83
R^2	0.2322	0.300	0.4600	0.22

"* ,**, and *** denote 10%, 5% and 1% significance level respectively. Numbers in brackets are robust standard errors. Column from (1) to (3) uses data from Persson et al. (2004) while column (4) uses corruption measure compiled by ICRG.

Table 6.7: Short run and Meduim run panel estimates of the relationship between inequality and growth. Fixed effects (FE) estimates are reported.

Estimation	(1)	(2)	(3)	(4)	(5)	(6)
Loggdp	-7.547	-10.420	-10.197	-17.173	-15.871	-15.660
	(3.271)**	(3.384)***	(3.648)***	(3.096)***	(2.638)***	(2.914)***
Gdi	0.017	0.043	0.001	0.273	0.291	0.240
	(0.103)	(0.095)	(0.104)	(0.063)***	(0.053)***	(0.057)***
Incomegini	0.172		0.175	0.139		0.155
	(0.147)		(0.153)	(0.137)		(0.125)
Ingini*corr	-0.047		-0.045	-0.041		-0.039
	(0.022)**		(0.024)*	(0.019)**		(0.017)**
Corruption	1.456	0.589	2.532	1.462	-0.778	1.135
	(0.835)*	(1.083)	(1.527)	(0.753)*	(0.722)	(1.171)
Education	0.045	0.044	0.051	0.048	0.045	0.045
	(0.030)	(0.027)	(0.030)	(0.021)**	(0.015)***	(0.018)**
Inflation	0.001	-0.011	-0.004	0.0001	-0.0001	0.0001
	(0.013)*	(0.012)	(0.013)	(0.0002)	(0.0001)	(0.0001)
Govt	-0.162	-0.076	-0.117	-0.230	-0.167	-0.164
	(0.073)	(0.077)	(0.078)	(0.080)***	(0.068)**	(0.072)**
Openness	0.048	0.032	0.042	0.020	0.020	0.022
	(0.030)	(0.024)	(0.030)	(0.015)	(0.013)	(0.014)
Time85				1.603	1.530	1.490
				(0.411)***	(0.353)***	(0.370)***
Time90	0.211	0.374	0.374	1.419	1.545	1.441
	(0.479)	(0.467)	(0.493)	(0.501)***	(0.423)***	(0.457)***
Time95				2.380	1.978	2.136
				(0.704)***	(0.558)***	(0.646)***
Land*Corr		-0.006	-0.012		0.010	0.004
		(0.013)	0.013		(0.010)	(0.011)
#obser.	81	83	78	169	151	151
groups	48	46	44	46	44	44
R^2	0.5756	0.4332	0.5581	0.4748	0.4304	0.4824
Hausman (p)	0.0298	0.0177	0.01	0.0002	0.0000	0.0000

Column (1) to (3) are panel medium-run estimates. (Data divided into 10 year periods) Column (4) to (6) are panel short-run estimates. (Data divided into 5 year periods) "*',**, and *** denote 10%, 5% and 1% significance level respectively.

Chapter 7

Non-Monotonic relations between Redistribution and Growth

7.1 Introduction

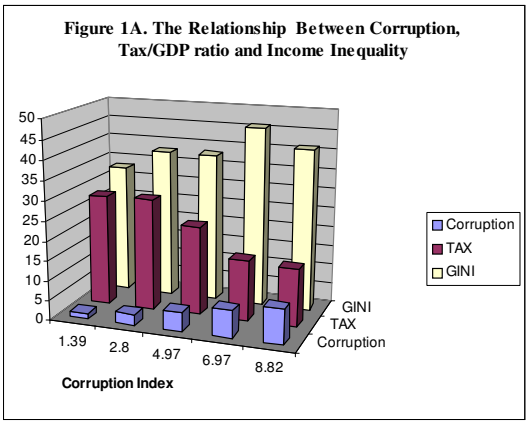
According to Acemoglu (1999) workers are heterogeneous with respect to two dimensions, i.e. formal education and actually acquired skills. The latter emanates from innate ability which is specific to an individual and is unobservable. Heckman *et al.* (1998) stress that the ability to acquire new skills after a technological shock is not perfectly related to observable education levels. They argue that, for a given educational level, within-group wage inequality has increased as a result of technological change. Acemoglu (1998) is capable to explain why residual wage inequality in the U.S. has steadily increased. Thus, individuals with very low levels of cognitive ability have a very hard time earning a decent wage rate.

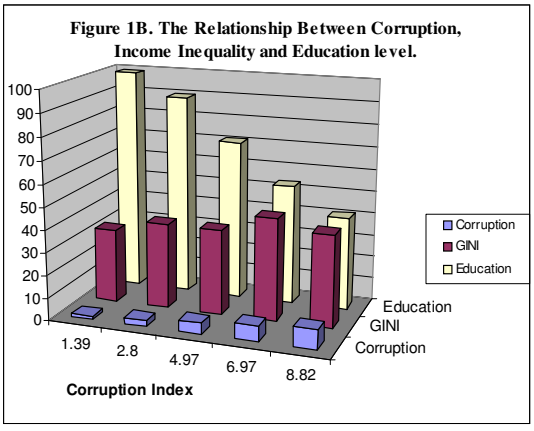
The problem of low skills as a source of inequality is not just a matter of low cognitive ability but also one of schooling. Studies of the United States have consistently shown that the real returns to an additional year of schooling are between 5% and 15% (see Ashenfelter and Krueger, 1994). Some estimates suggest that the returns are even higher in developing countries (Psacharopoulos, 1994). By investing or borrowing, individuals with low ability can upgrade their human capital. Investment in human capital affects income distribution mainly through

the labor market. People with more education earn more in wage employment than people with less education.

Nevertheless, the choice of going to school depends on whether one is able to invest or not in human capital. People with higher inheritance tend to invest in education than otherwise. Thus difference in bequests tend to make intra-generational transfer of wealth a source of increased inequality. As an alternative to inheritance as a source of finance, poorer individuals may borrow given that there are no capital market imperfections. However, poorer people may be credit constrained from borrowing against expected future income to pay for their education today, especially because human capital can not act as a collateral. Since a low level of human capital can limit an individual's earning ability and the fact that the poor could be credit constrained, government redistributive programmes are the obvious remedy to have more schooling or better schooling. If this would be valid in general, the question arises why do some countries under-invest in human capital while others don't?

The answer to this question lies in the mix of institutional setup and the degree of inequality. Figures 1A and 1B show the relationship between redistributive measures (Tax/GDP ratio) and level of education with respect to the level of corruption and the degree of inequality.





The diagrams show that in countries where a higher level of inequality and corruption dominate the economy, there is a low level of Tax/GDP ratio and a low

accumulation of human capital, consequently there are lower growth rates. One of the explanations given for this phenomenon is the existence of wealth bias in a political system. Taking the case of East Asian and Latin American countries as an example, South Korea and Taiwan engaged in early redistribution through land reform and higher pro-poor public spending so as to win political power against communist insurgency. By contrast, Latin American countries have long histories of high income inequality and find it difficult to raise taxes as policies are twisted towards the benefit of urban elites. For more on such circles, see Addison and Rahman (2001). Perotti (1996) finds that redistribution, proxied by different government redistribution measures, is positively related to less unequal societies.[1]

Results from part II of the thesis indicate that it is possible that higher income inequality could lead to lower tax revenues, because the rich are able to exert a disproportionaly powerful impact on the political system. The extreme rich ones would not like to pay taxes as this will lower their income. Instead, they tend to bribe politicians in an effort to get exempted.

The consequence of lost revenue could be bad, in particular, if countries are below the optimal tax threshold, in the region where higher taxes could mitigate liquidity constraints that will lead to higher growth. This is especially true if higher transfer is used to relax some of the credit constraints described in the previous section, for example, through education spending. As a result, income inequality may lead to lower growth not because it increases taxes but rather due to lower taxes, opposite to the conventional explanations.

Nevertheless, higher taxes could lead people to opt to go out of work and prefer to invest in political activity. Reduced supply of effective labour supply might lead to lower growth. Therefore, whether taxes are good or bad depends on the position of the tax rate.

This chapter provides empirical evidence for the theoretical prediction reported

[1]Note that this is contrary to the papers of Bertola (1993), Alesina and Rodrik (1994) and Persson and Tabellini (1994). They show that greater skewness in the distribution of income leads to more redistribution in democratic societies. However, the evidence for a negative relationship between growth and redistribution is weak.

in part II of the thesis. We build systems of equations and estimate the model using three stage least squares to analyze the relationship between taxes, education and growth variables.[2] Moreover, we also explore panel estimates. Our findings are: both corruption and income inequality significantly reduce the tax/GDP ratio; the relationship of growth with respect to both effective tax rate and level of education is non-monotonic, the relation between effective tax rate and level of education is nonlinear. We proceed in the following fashion. In the next section we state our hypotheses which emanates from the theoretical predictions of Part II of the thesis. Moreover, we discuss below more thoroughly the variables we are interested in, like the effect of wealth inequality and corruption on redistributive outcomes. In section 7.3, we present the data and estimation methods. In section 7.4 we test empirically our hypothesis. The last section concludes.

7.2 Hypotheses

In this section, we lay out our hypotheses. From Part II of the thesis, we establish that increasing taxes above the growth maximizing tax rate lowers growth but for low values of the tax rate more redistribution goes along with higher growth. Second, given the two sector model that we have, an increase in the number of skilled only increases growth if the number of unskilled is relatively large, i.e. if the number of skilled is below its optimal level. There exist a non-linear relations between level of education, taxes and economic growth.

Third, from Chapter 4 we also establish that countries which start from equal distribution of wealth will end up in the long run with a higher number of skilled people[3] and lower tax rate leading to a higher growth. Note that the key feature of the theoretical model is that individuals differ in their inheritances which affects

[2]Recent papers that use 3SLS, include Barro (2000) and Lundberg and Squire (2003), to examine determinants of the simultaneous evolution of growth and inequality.

[3]This is similar to the predictions made by Galor and Ziera (1993), they claim that countries inwhich their initial wealth distribution is fairly distributed will have a higher chance of ending up with a large number of skilled people.

the number of skilled and unskilled individuals.

Fourth, our model predicts that higher income inequality could lead to lower taxes. Results from chapter 4 indicate that if there happens to be an increase in technological progress, implying an increase in the wage of skilled workers, it will become worthwhile for the unskilled to undertake more lobbying activities and supply less labour. This will lead to an increase of the tax that is used for inter-generational redistribution. Since the political outcome depends not only on political activity but also on group size, there exists a mechanism where taxes are blocked by opposing forces. If the group size effect is stronger than the political activity effect, then we might face low tax rates in the long run.

Last but not least, the theoretical analysis revealed that a higher inequality does not necessarily yield a higher redistribution. The effect could even be reversed if inequality emerges in a situation where there is a wealth bias in the political system. Thus, technological change that widens the wage gap between skilled and unskilled will result in a decrease of the tax base as more people have now an incentive to ask for exemption. This in turn erodes the tax base leading to a lower tax revenue assumed to have a direct link with human capital accumulation and growth.

7.3 Data and Model Specification

To find appropriate variables to proxy redistribution in the political economy models is not easy exercise. In the political economy approach, the fiscal channel works through the distortionary use of taxation and redistributive expenditure suggests the use of the marginal tax rate as a proxy for the distortionary use of taxation. However, the marginal tax rate only measures the progressivity of the fiscal system while redistribution is the result of the complex interaction between the initial extent of inequality, the average tax rate, the level of progressivity and the extent and composition of pubic expenditure. In order to take all these components into account, other indices to proxy the redistributive effort of fiscal policy are included in different studies: among others, the ratio of total government expenditure to GDP and the ratio of total tax revenues to GDP. However, other issues such as the

legislation on capital gains, collective contracts, wage ceiling and minimum wage all impose very strong constraints on the level of pre-tax inequality but are not picked up by any existing index. The lack of a comprehensive index of redistribution able to encompass all these components suggest that existing measures only provide a partial representation of it. Here we proxy our redistribution variable via Tax/GDP ratio.

The education level, in our regression analysis, is proxied by the enrollment ratio in secondary schooling. Primary education is compulsory and free in many countries. Even though a higher education may also be free in some countries, it is never compulsory (i.e. a decision variable of households) and comes at the cost of forgone consumption.

For many years, it was argued that using income inequality as a proxy for the inequality of wealth is not a serious problem as the shapes of the two distributions are believed to be similar in a cross section of countries. However, recent empirical evidence shows that albeit the distributions are correlated, it does make a difference whether one uses inequality of income or wealth. See Deininger and Olinto (2000). When analyzing inequality, it is important to distinguish between accumulated wealth (i.e. assets) and current income. There are at least three reasons why the distribution of wealth is an important factor in explaining inequality. First, ownership of financial wealth is a significant source of income: inequity in the distribution of wealth implies a corresponding inequity in the distribution of dividends, interest, rent and other income received by wealth owners. Second, wealth provides security: a wealthier household is better able to cope with negative shocks. Finally, wealth brings its owners political and economic power in several forms. Some authors, use initial land distribution as a proxy for wealth distribution. The relevance of this proxy is that possession of land could be a major determinant of individuals productive capacity (their ability to invest) and, moreover, it doesn't require assumptions regarding the mapping from income flows to stocks of assets. In the regressions, we use land inequality as a proxy for differences in the initial inheritance distribution.[4]

[4]Nevertheless, using land distribution as a proxy for wealth distribution is not without prob-

We will use income inequality, compiled by the Texas Inequality Project to proxy wage inequality which is available for quite a long time which is convenient for panel data analysis. Data for before tax and after tax household incomes for the same countries hardly exist. Even the high quality data set compiled by Deininger and Squire (1996) that is based on household incomes includes government transfers. We do not use data on Inequality from Deininger and Squire (1996) as observations for the mid-1990s are hardly available.

More so, checking our hypotheses requires a measure of wealth bias to be included in the regression analysis. In principle, the required parameter should represent an evaluation of institutional set up reflecting weak governance, bad tax administration and excessive tax evasion. Clearly, there is no simple way to assess the measure of wealth bias across countries. The closest we can think of is "corruption". It becomes natural to think that in societies where corruption is prevalent, excessive exemptions are observed and thus a lower score of tax/GDP ratio.

Following recent studies on the relation between inequality and growth, we also consider many other control variables in our regression analysis; e.g. the log of initial GDP per capita, domestic investment share of GDP (GDI), education level, tax GDP ratio, openness (defined as sum of exports and imports over GDP), ethnicity, political right index and fertility rate.

Tables 7.1 and 7.2 report summary statistics of the variables used in the paper (See Appendix). Our study attempts to identify the relationship between the aforementioned variables. Having securing data for 20 years of 53 countries, we would be able to form panel with 4 periods, namely, 1980-1984, 1985-1989, 1990-1994 and 1995-1999, 53 countries. Furthermore, in order to abstract from business cycle effects, similar to Islam (1995) and Lundberg and Squire (2003), we use five-year averages of the growth variable while most of the control variables are at their

lems. The first shortcoming of land inequality is that few observations exist within countries and as a result this is difficult to use for panel data studies. Second, the contribution of land towards GDP is higher for less developed countries than for developed countries. Moreover, the data of land inequality are compiled at the beginning of each decade which makes it difficult to use for panel data analysis.

initial values. In other words, the explanatory variables are at their initial values in a 5-year period. Earlier data and wide coverage are not considered due to the incompleteness of data on corruption. The main indicators for corruption used in this analysis are Transparency International (TI)'s.

To address the risk of using an inappropriate estimation method, we used two variants of estimation methods, viz. panel estimates and 3SLS. This data set allows us to consider various specification for panel data models. We also estimated the growth regression using both the fixed-effects and the random effects models.[5] This permits us to partially mitigate the confounding impact of omitted variables on the inequality-growth relationship by controlling for country-specific effects via the following specification.

$$\begin{aligned} g_{it} &= G_1(LogGDP_{i,\,t-1}, TAX_{i,\,t-1}, TAX^2_{i,\,t-1}, EDU_{i,\,t-1}, EDU^2_{i,\,t-1}, \\ &\quad GOVT_{i,\,t-1}, OPEN_{i,\,t-1}, INEQ_{i,\,t-1}, CORR_{i,\,t-1}, \eta_i) + u_{it} \end{aligned} \tag{7.1}$$

where $i = 1, 2, ...N$ (number of countries) and the subscript $t = 1, 2, ..., T$ (five-year time period). g_{it} is real GDP growth rate, $LogGDP_{i,\,t-1}$ is the log of lagged per capita real GDP level; $EDU_{i,\,t-1}$ the education level proxied by the enrollment ratio in secondary schooling and $TAX_{i,\,t-1}$ is the tax revenue/GDP ratio; $GOVT_{i,\,t-1}$ is government consumption ratio; $OPEN_{i,\,t-1}$ is openness to control for the role of international factor mobility to economic growth; $INEQ_{i,\,t-1}$ is lagged for a five year period Income. The right hand side variables are all initial values in the 1980, 1985, 1990, 1995. Where as η_i is unobserved heterogeneity with variance σ^2_η. It can be viewed as unobserved country characteristics e.g. due to technical inefficiency, that are constant over time and influence g_{it}; and u_{it} is an idiosyncratic error term with variance σ^2_u. Moreover, in order to capture nonlinearity between tax rates, education and growth - as predicted by the theory - we include the squared terms EDU^2_{t-1} and TAX^2_{t-1} to the growth equation.

Our focus is not only on investigating the relationship between growth and in-

[5]It could have been optimal to combine the two estimate model so as to take the fixed effects and endogeneity at the same time. However, the instruments used to fix the problem of endogeneity are time invariant variables making difficult to estimate the fixed effects.

come inequality but also on how inequality and corruption affect the development of taxes and education levels which in a way are important variables to growth. In order to understand the channels as to how inequality and corruption affect the development of these variables, we run 3SLS. Studies conducted to examine the relationship between growth versus inequality using a system of equations hardly exist with the exception of Barro (2000) and Lundberg and Squire (2003). Based on cross-country panel data, Barro (2000) applies 3SLS and finds that the overall relationship between inequality and growth is almost zero. Lundberg and Squire (2003) examine determinants of the simultaneous evolution of growth and inequality. They find that low inflation, education and land redistribution improves growth and lowers income inequality. Neither paper, however, includes redistributive policy measure as an endogenous variable nor examines the channel through which growth is affected, which is relevant for testing our hypothesis. It is important to note that human capital accumulation, the growth rate, and the tax rate are simultaneously endogenous. To take into account these endogenous interactions, we first build the following system of equations:

$$\begin{aligned} g_t &= G_2(LogGDP_{t-1}, GDI_{t-1}, TAX_{t-1}, TAX^2_{t-1}, \\ &\quad GOVT_{t-1}, POL, OPEN_{t-1}) \end{aligned} \tag{7.2}$$

$$\begin{aligned} g_t &= G_3(LogGDP_{t-1}, GDI_{t-1}, EDU_{t-1}, EDU^2_{t-1}, \\ &\quad GOVT_{t-1}, POL, OPEN_{t-1}) \end{aligned} \tag{7.3}$$

$$\begin{aligned} g_t &= G_4(LogGDP_{t-1}, GDI_{t-1}, TAX_{t-1}, TAX^2_{t-1}, EDU_{t-1}, \\ &\quad EDU^2_{t-1}, GOVT_{t-1}, POL, OPEN_{t-1}) \end{aligned} \tag{7.4}$$

$$TAX_{t-1} = T(INEQ_{t-1}, CORR_{t-1}, GOVT_{t-1}, ETHNIC) \tag{7.5}$$

$$EDU_{t-1} = E(TAX_{t-1}, TAX^2_{t-1}, INEQ_{t-1}, FERTILITY_{t-1}) \tag{7.6}$$

We have three variants of the growth equation. Looking at the propositions established from Part II of the thesis, both taxes and level of education are the mirror of each other to the growth system. In order to minimize multicollinearity, we place taxes and education level one after another in the growth equation of (7.2) and (7.3). We also checked whether the inclusion of these variables together in a growth equation (7.4) alters the results.

Most growth regressions include controls for physical capital investment (GDI_{t-1}) and the log of lagged level of GDP as indicated in equation (7.2). Easterly *et al.* (1993) include both primary and secondary enrollment, but here we take only secondary enrollment as primary school entrance is almost free of cost. We also include openness to control for the role of international factor mobility to economic growth. Finally, we include the government consumption ratio and the political right index in the growth equation.

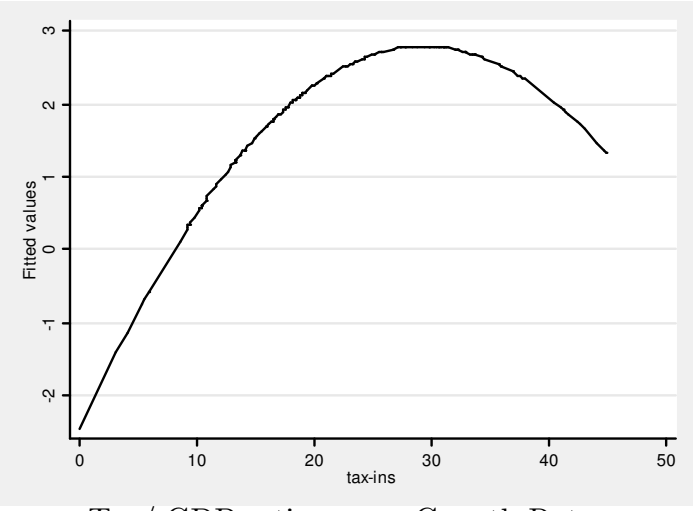
Equation (7.5) aims at examining the determinant of tax GDP ratio. Besides inequality and corruption variables, we also include ethnicity and government consumption as additional variables. The first variable is to control for the well documented fact that highly fragmented societies do have inefficient government redistributive measures (See for more Easterly *et al.* (2000)) while the latter variable is included to control for the response of the tax revenue due to an increase in demand for government programmes. Similarly, equation (7.6) shows the educational variable as a function of effective tax rate and land inequality. We also include the fertility rate in the education equation as an instrument, since a higher fertility rate affects the development of education negatively. See Barro (2000) and Perotti (1996).

7.4 Empirical Results

In this section, we present basic evidence for our hypotheses. The question we raised is how inequality and corruption affect the collection of tax revenue and the accumulation of human capital and thereby economic growth. Table 7.3 shows the results of the estimates of panel regression i.e. equation (7.1). Since the

Hausman specification test points out that in almost all specifications the random effects are violated, we report the results from the fixed-effect approach.[6] From Table 7.3 column 1 it becomes clear that the results estimated from 3SLS are robust i.e. the education and the tax variable enter into the growth equation with expected sign and are also statistically significant. In Figure 7.1 below, we plot the relationship between growth and Tax/GDP ratio at the sample means of all significant variables. Consistent with our theory, the Tax variable has a positive and significant sign, but the marginal effect of taxes is declining as Tax^2 has a negative sign and is statistically significant suggesting the nonlinear effect of taxes to growth. Evaluated at the sample mean, a unit increase in Tax/GDP ratio causes an increase in growth by 0.087 units ($= 0.357 - 0.006$ x 2 x 22.541). As illustrated by figure 7.1, a unit increase of Tax/GDP ratio at sufficiently high values reduces growth rates. At a Tax/GDP ratio 2 SD above the mean , the effect of an increase in Tax/GDP ratio on growth falls somewhat to -0.18. Similarly, the relationship between education and growth is also non monotonic. The education variable has a positive and significant sign, but the marginal effect education is declining as Education^2 has a (small) negative and significant coefficient. This implies that an increase in the number of skilled only increases growth if the number of unskilled is relatively large, i.e. if the number of skilled is below its optimal level. A unit increase in education level has 0.029 effect on growth rates ($0.174 - 0.001$ x 2 x 72.277).

[6] In both panel estimates the subset of coefficients that are estimated by the fixed effects estimator and the random effects estimators are significantly different suggesting that η_i and $\mathbf{X}_{it}^{'}$ are correlated. The null Hypothesis that there is no systematic difference in coefficients is rejected as p value is less than 5%, Hausman is in favour of the fixed effects estimator. (See Table 5)



Tax/ GDP ratio versus Growth Rates

Moreover, government consumption ratio has the expected sign and is statistically different from zero. We find openness to positively relate to the growth rates and is statistically significant. The coefficient of income inequality is negative and significant. However, the corruption variable is insignificant. In column 2 of Table 7.3 we include the interaction term between inequality and corruption. The fit of the model improves slightly i.e. by 3%. The coefficient on inequality is not any more significant while corruption changes its sign and becomes statistically significant. However, the net effect of corruption is negative as the coefficient of the interaction term between inequality and corruption is negative and statistically significant at 5%.[7] As one can see from Table 7.3, the results of the rest of the variables remain unchanged.

We now turn to the results of the 3SLS. In 3SLS estimator, η_i is assumed to be zero, and μ_i,$_t$ are i.i.d. and independent of all explanatory variables. In other words, 3SLS assumes that the intercepts do not vary across all countries (homogenous), that each observation is cross sectional and time-series independent and that all explanatory variables are strictly exogenous.[8]

[7] Higher corruptibility clearly correlates with lower growth rates. A unit increase in corruption decreases growth (at the mean) by 0.028 units ($= 1.717 - 0.044$ x 39.669).

[8] Clearly, these assumptions are restrictive: e.g. if there are country-specific effects on growth, the homogeneity assumption will be violated.

We start our analysis from Table 7.4 which estimates the growth equation (7.2), tax equation (7.5) and education equation (7.6) using 3SLS. To check the robustness of inequality measurement, we also run the same regressions with income inequality, land inequality and the nested model (it places both measures of inequality in one regression) as shown in column (1), (2) and (3) of Table 7.4 respectively. Running regressions with income and land inequality do not change the results substantially for the growth equation. From Table 7.4, consistent with our theory, the Tax variable has a positive and significant sign, but the marginal effect of taxes is declining as Tax^2 has a negative sign and is statistically significant suggesting the nonlinear effect of taxes to growth.

Table 7.5, estimates equation (7.3) which takes into account the education variable in the growth equation. Consistent with our hypothesis, the relationship between education and growth is also non monotonic. The education variable has a positive and significant sign, but the marginal effect of education is declining as Education^2 has a (small) negative and significant coefficient. This implies that an increase in the number of skilled only increases growth if the number of unskilled is relatively large, i.e. if the number of skilled is below its optimal level. For example, from column two of Table 7.5, the net effect of education to growth (evaluated at sample means) is 0.104 ($= 0.252 - 0.001$ x 2 x 73.905).

Table 7.6 estimates equation (7.4). It places both the education and tax variable in the growth regression and checks whether the estimation results are sensitive to multi-collinearity problem. Indeed, the growth regression performs poorly compared to the estimated equations of (7.2) and (7.3) in terms of significance level of the education and tax/GDP ratio variables, suggesting the endogeneity of the two variables. Looking at Table (7.4), (7.5) and (7.6), while the education and tax variables have the expected sign, their significance level varies dramatically when one uses income or land as measure of the degree of inequality.[9]

[9]However, F test shows that estimates of both the education and tax variables are jointly significant. For example, from Column 1 of Table 7.6, though the education variables (Education, Education^2) are individually insignificant, F-test reveals that both the education and its square term are jointly significant. The Null Hypothesis that the coefficient of both variables is zero, is

From the growth regression of Tables (7.4), (7.5) and (7.6), we can see that the control variables are highly significant. For example, the investment variable has a positive and significant effect to economic growth. The coefficient of per-capita income is negative and statistically significant suggesting conditional convergence. Similar to the findings of Barro (2000), the measure of government ratio and the political right index have negative signs and are statistically different from zero at 1%. Similar to Easterly and *et al.* (1993) measure of trade openness i.e. the ratio of imports and exports to GDP, we find that openness negatively enters to the growth equation, although the coefficient of openness is insignificant with the exception of results in Table 7.4, 7.5.

From the tax equation, we find corruption and ethnicity to negatively affect raising tax revenue that could be useful for the accumulation of human capital. Similar to our hypothesis land inequality is positively affecting the tax/GDP ratio and this is consistent with the findings of Alesina and Rodrik (1994). However, we find income inequality to negatively affect tax/GDP ratio. Moreover, our findings corroborate recent empirical research which shows smaller government size is found to be associated with higher levels of corruption (La Porta *et al.* 1999). The government consumption ratio as a regressor, however, is positively related to the tax/GDP ratio as one would expect.

The education equation suggest that the coefficient of Tax/GDP ratio and its square term have a positive and negative sign respectively, indicating the nonlinear relationship of tax rate and accumulation of human capital. This is observed from the reduced form education regression of Table 7.4, 7.5 and 7.6. We also find the fertility variable to negatively affect the development of human capital accumulation. Similar to Perotti (1996) and Figini (1999), we also find land inequality to negatively affect the development of school enrollment ratios.

---

rejected at 1%. Similarly, the tax variable in Column 2 and Column 3 are jointly significant both at 1% and 6% significance level.

7.5 Conclusion

In an attempt to give the theoretical predictions of part II of the thesis empirical support, we run a system of equations using panel-data on per-capita growth, education level, and tax/GDP ratio. The effect seems to be strong enough to allow confidence in its support for our hypothesis. The adverse effect of redistributive measure and human capital accumulation is entirely captured by the degree of inequality and corruption. Both taxes and education positively and significantly contribute to growth rates, though their relation is nonlinear in growth rates.

We showed how income inequality and corruption simultaneously result in a smaller redistributive outcome. The channel we suggest and examine is to endogeneize the education level, tax and growth rates. Clearly, the development of these variables may be severely damaged by inequality that prevails in wealth biased system of politics. In a situation where wealth bias in political decision making is prevalent, the tax base is likely to be eroded and lower effective tax rates (per capita tax or per capita transfer) are observed, making it difficult to finance education.

Given the fact that the empirical findings confirm the non positive relationship between the two variables, the implication is that effective redistribution of wealth can promote growth. That of course leaves open the question of whether such redistributions are feasible, because political decisions are easily twisted by those people who are well advantaged. Broadly interpreted, our results show that an equalizing redistribution of wealth coupled with good institutions lead to a higher accumulation of human capital and this raises economic growth.

Appendix to Chapter 7

Appendix. Description and source of the Data used for chapter 6 and 7.

Corruption: It is from Transparency International (a coalition against corruption in international business transactions). This index is based not only on the locals but also on international surveys of business people and reflects their impressions and perceptions of the countries surveyed. The index is available from 1980-85, 1988-92, and 1995-2002. It ranks countries on a scale of 0 (completely corrupt) to 10 (clean). For conformity, we inverted the scale i.e. 0 means the lowest level of corruption and 10 is the highest. (www.transparency.de)

Growth rate of Real GDP per Capita (Growth): World Bank's World Development Indicators (WDI). We choose WDI rather than the Penn World Trade because the WDI is more updated and it contains more observation for extended time periods than the latter. (average of 80-84,85-89,90-94,95-99)

Income Inequality [**IncomeGini**]: Estimated household income inequality is used as a measure of income Gini. It is available for a long period of time. This approach uses econometric methods to estimate the relationship between income inequality and pay inequality. The estimates are conditioned by other variables, including the relative size of the manufacturing sector, for a matched set of observations covering just over 500 data points in Deininger and Squire. The estimated regression coefficients are available from http://utip.gov.utexas.edu/ web site. The index takes values between 0 and 100, with a higher number indicating greater inequality.

Land Gini [**LandGini**]: is from FAO which compiles summaries of official "Agricultural Census". Source (Klause Deininger and Pedro Olinto). The index takes values between 0 and 100, with a higher number indicating greater inequality.

Gross Domestic Investment % of GDP (Gdi): is the ratio of real investment to real GDP. The measure is the average of the annual observations on the ratio for each of the periods.

Log of Initial GDP per capita (Loggdp) is from **CD Room of WDI**

2003.

Tax revenue (% of GDP) (Tax). Tax revenue comprises compulsory transfers to the central government for public purposes. Compulsory transfers such as fines, penalties, and most social security contributions are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue. Data are shown for central government only. Source World Development Indicators 2003.

Education (Educins): The proxy for human capital endowment is secondary schooling enrollment ratio.

Openness: openness, defined as the sum of exports and imports of goods and services as a share of gross domestic product. Source: The World Bank's World Development Indicators CD-Rom 2003.

Ethnicity: the proxy for ethnicity is an index of ethno linguistic fractionalization for 1960. It measures the probability that two randomly selected persons from a given country will not belong to the same ethno linguistic group. Source: Easterly and Levine Data Set, World Bank, 2001.

Fertility rate: Fertility rate, total (births per woman) Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with prevailing age-specific fertility rate is the number of infants dying before reaching one year of age, per 1000 live births in a given year. WDI CD Room 2004.

General government consumption (Govt) it includes all government current expenditures excluding military expenditures that are part of government capital formation. WDI CD Room 2003.

Political Rights Index [Polright] is an index that measures the level of political freedom. The index ranks countries on a scale of 0 to 7. We reversed the scale and converted the original ranking of 0 to 7 into a scale of 0 to 10 where the higher the score means the lower the level of political freedom.

Table 7.1: Descriptive Statistics of the Variables Used for 3SLS

Variable	N=161		N=146	
	Mean	Std.Dev.	Mean	Std.Dev
Growth	1.990	2.097	1.994	2.120
Loggdp	3.899	0.420	3.888	0.420
Gdi	22.447	5.127	22.329	5.165
Education	74.081	30.755	73.905	29.990
Tax	22.952	9.840	23.032	9.951
IncomeGini	38.518	7.031	39.364	6.100
LandGini	62.954	16.497	63.331	16.674
Corruption	4.677	2.643	4.604	2.648
Openness	61.424	39.812	59.839	32.031
Govt	16.502	6.066	16.663	6.207
Fertility	2.835	1.484	2.893	1.503
Ethnic	31.674	28.689	31.078	28.914

Table 7.2: Descriptive Statistics for Variables Used In Paanel Estimates

Variable	Obs	Mean	Std.Dev.
Growth	152	1.883	2.321
Loggdp	152	3.864	0.447
Education	152	72.366	30.715
Tax	152	22.523	10.150
IncomeGini	152	39.669	6.278
LandGini	188	64.114	16.874
Corruption	152	4.719	2.683
Openness	152	61.424	39.812
Govt	152	16.510	6.165

Table 7.3: Short run panel estimates of the non monotonic relationship between taxation, education and growth

	(1)		(2)	
Growth	Coef.	Std. Err.	Coef.	Std. Err.
Loggdp	-11.787	(2.908)***	-12.552	(2.889)***
IncomeGini	-0.121	(0.059)**	0.176	(0.159)
Tax	0.357	(0.178)**	0.313	(0.176)*
Tax^2	-0.006	(0.003)*	-0.006	(0.003)*
Education	0.174	(0.064)***	0.208	(0.065)***
$Education^2$	-0.001	(0.0003)*	-0.001	(0.0003)**
Corruption	-0.007	(0.253)	1.717	(0.895)*
Govt	-0.250	(0.094)***	-0.247	(0.093)***
Openness	0.048	(0.016)***	0.046	(0.015)***
Corr*gini			-0.044	(0.022)***
R^2	0.33		0.36	
Observations	152		152	
Hausman(p-value)	0.03		0.01	

*,** and*** denotes significance at 10, 5 and 1% level respectively.

Table 7.4: Estimates of Three Stage Least Squares of Growth, Education and Tax/GDP ratio: averaged over 5 years

	Income Gini		Land Gini		Nested	
	(1)		(2)		(3)	
	Coef.	Std.Err	Coef.	Std.Err	Coef.	Std.Err
Growth						
Loggdp	-8.376	(1.679)***	-7.604	(1.208)***	-6.077	(1.178)***
Gdi	0.203	(0.054)***	0.204	(0.042)***	0.204	(0.043)***
Tax	2.306	(0.610)***	2.538	(0.491)***	2.013	(0.481)***
Tax^2	-0.038	(0.011)***	-0.042	(0.008)***	-0.034	(0.009)***
Govt	-0.219	(0.063)***	-0.235	(0.054)***	-0.201	(0.052)***
Polright	-0.428	(0.132)***	-0.386	(0.110)***	-0.382	(0.108)***
Openness	-0.022	(0.011)***	-0.027	(0.008)***	-0.019	(0.009)**
Constant	7.425	(4.346)	2.074	(3.492)	1.845	(3.465)
Tax						
Corruption	-0.595	(0.335)*	-0.826	(0.284)***	-0.385	(0.343)
IncomeGini	-0.362	(0.123)***			-0.438	(0.128)**
LandGini			0.026	(0.033)	0.061	(0.034)*
Govt	0.638	(0.126)***	0.792	(0.122)***	0.701	(0.126)***
Ethnic	-0.041	(0.020)**	-0.050	(0.019)**	-0.035	(0.021)*
Constant	30.530	(5.265)***	13.597	(3.745)***	27.588	(5.490)***
Education						
Tax	8.815	(3.165)***	7.910	(2.815)***	8.094	(2.626)***
Tax2	-0.138	(0.059)**	-0.122	(0.052)**	-0.130	(0.049)***
Fertility	-6.848	(2.437)***	-8.883	(1.909)***	-8.581	(1.815)***
LandGini					-0.204	(0.0874)**
Constant	-21.332	(41.715)	-6.285	(36.539)	6.649	(34.076)
Observations	151		161		146	
Countries	53		53		53	
χ^2	93.58/176.16/167.19		99.85/165.77/217.51		80.66/171.98/220.36	

*,** and *** denotes significance at 10, 5 and 1 percentage level respectively.

Table 7.5: Estimates of Three Stage Least Squares of Growth, Education and Tax/GDP ratio: averaged over 5 years

	Income Gini		Land Gini		Nested	
	(1)		(2)		(3)	
	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Growth						
Loggdp	-5.822	(1.757)***	-7.730	(2.073)***	-6.169	(1.707)***
Gdi	0.165	(0.042)***	0.155	(0.043)***	0.146	(0.039)***
Education	0.181	(0.079)**	0.252	(0.093)***	0.196	(0.074)***
Education^2	-0.0006	(0.0004)	-0.001	(0.0005)**	-0.0007	(0.0004)*
Govt	-0.087	(0.039)**	-0.059	(0.039)	-0.074	(0.036)**
Polright	-0.285	(0.121)**	-0.350	(0.138)**	-0.309	(0.121)***
Openness	-0.001	(0.007)	-0.005	(0.007)	-0.0002	(0.006)
Constant	14.261	(4.753)***	19.333	(5.560)***	15.507	(4.657)***
Tax						
Corruption	-0.613	(0.335)*	-0.804	(0.285)***	-0.327	(0.344)
IncomeGini	-0.358	(0.123)**			-0.460	(0.129)***
Land			0.029	(0.033)	0.072	(0.034)**
Govt	0.644	(0.126)***	0.800	(0.122)***	0.709	(0.126)***
Ethnic	-0.040	(0.020)**	-0.050	(0.020)**	-0.035	(0.021)***
Constant	30.317	(5.262)***	13.198	(3.754)***	27.030	(5.514)***
Education						
Tax	7.108	(3.109)**	7.618	(3.083)***	9.077	(3.048)***
Tax^2	-0.108	(0.057)*	-0.117	(0.057)**	-0.148	(0.056)***
Fertility	-8.358	(2.506)***	-9.685	(2.193)***	-8.707	(2.183)***
LandGini					-0.332	(0.126)***
Constant	3.153	(41.619)	-0.224	(40.525)	4.147	(40.600)
Observations	151		146		146	
Countries	53		53		53	
χ^2	67.48/177.96/191.08		64.45/17062/160.90		61.86/170.27/178.25	

*,** and*** denotes significance at 10,5 and 1 percentage level respectively.

Table 7.6: Estimates of Three Stage Least Squares of Growth, Education and Tax/GDP ratio

	Income Inequality		Landgini		Nested	
	(1)		(2)		(3)	
	Coef.	Std.Err	Coef.	Std.Err	Coef.	Std.Err
Growth						
Loggdp	-8.169	(2.492)***	-9.012	(2.089)***	-7.945	(1.766)***
Gdi	0.108	(0.062)*	0.151	(0.044)***	0.150	(0.042)***
Tax	2.821	(1.197)**	0.937	(0.563)*	0.618	(0.464)
Tax^2	-0.047	(0.021)**	-0.015	(0.010)	-0.010	(0.008)
Education	0.076	(0.210)	0.252	(0.113)**	0.236	(0.082)***
$Education^2$	-0.001	(0.001)	-0.001	(0.001)**	-0.001	(0.0004)***
Govt	-0.245	(0.069)***	-0.149	(0.051)***	-0.123	(0.046)***
Polright	-0.488	(0.197)***	-0.451	(0.141)***	-0.441	(0.125)***
Openness	-0.024	(0.013)*	-0.013	(0.008)	-0.006	(0.008)
Constant	2.823	(10.663)	15.886	(7.012)**	15.352	(5.681)***
Tax						
Corruption	-0.260	(0.335)	-0.807	(0.284)***	-0.339	(0.343)
IncomeGini	-0.355	(0.123)			-0.448	(0.129)***
LandGini			0.028	(0.033)	0.071	(0.034)***
Govt	0.644	(0.126)***	0.799	(0.122)***	0.706	(0.126)***
Ethnic	-0.040	(0.020)**	-0.050	(0.019)***	-0.036	(0.021)*
Constant	30.248	(5.260)***	13.262	(3.752)***	27.129	(5.505)***
Education						
Tax	6.783	(3.122)**	7.451	(3.093)**	8.983	(3.055)***
Tax^2	-0.102	(0.058)*	-0.114	(0.057)**	-0.146	(0.057)***
Fertility	-8.543	(2.502)***	-9.801	(2.192)***	-8.761	(2.181)***
LandGini					-0.326	(0.125)***
Cons	7.361	(41.709)	2.131	(40.617)	5.046	(40.665)
Observations	151		161		146	
Countiries	53		53		53	
χ^2	96.02/178.35/189.84		57.06/165.15/201.17		67.17/170.70/177.23	

*,** and *** denotes significance at 10,5 and 1 percentage level respectively.

Summary in Dutch

Zoals besproen in de introductie van dit proefschrift laat noch de theoretische literatuur, noch het empirisch onderzoek eenduidige, niet-ambigue resultaten zien met betrekking tot de effecten van ongelijkheid op economische groei. Dat men er kennelijk niet in slaagt consistente empirische resultaten te vinden in antwoord op de vraag hoe ongelijkheid economische groei beïnvloedt, wordt aan een aantal factoren toegeschreven, zoals de gevoeligheid van de resultaten voor het onderzochte tijdsbestek, de modelspecificatie, meetfouten en de heterogeniteit van vergelijkbare data. Het blijkt bijvoorbeeld dat het hanteren van gemiddelden over een periode van 20 jaar of meer, 10 of 5 jaar in een regressie-analyse leidt tot de conclusie dat ongelijkheid respectievelijk negatieve, neutrale of positieve effecten heeft op de economische groei. Andere 'excuses' die in de literatuur gegeven worden zijn het moeilijk kunnen controleren voor landspecifieke effecten en de onvergelijkbaarheid van data (Atkinson en Brandolini, 2001). Om dit probleem het hoofd te bieden, richt men in recent onderzoek de aandacht op landspecifieke studies om bias te minimaliseren en consistente en vergelijkbare data te verkrijgen. Deze exercities hebben echter niet geresulteerd in een consistente relatie – positief of negatief – tussen niveaus van ongelijkheid en economische groei. Dat wil zeggen dat er nog steeds geen sterke wetmatigheid in het verband tussen ongelijkheid en economische groei is, of tenminste geen simpele rechtlijnige relatie tussen beide.

Wat ook de mogelijke verklaringen mogen zijn voor het feit dat de empirische resultaten niet eenduidig zijn, de tolerantie die verschillende samenlevingen aan de dag leggen voor dezelfde mate van ongelijkheid, zou ook kunnen verschillen, afhankelijk bijvoorbeeld van de bron van die ongelijkheid. Met andere woorden, ongelijkheid kan voor verschillende mensen verschillende dingen betekenen omdat

het ontstaan daarvan afhankelijk is van verschillende factoren. Daarom worden in het eerste gedeelte van dit proefschrift economische experimenten ontworpen en uitgevoerd. Het doen van experimenteel onderzoek wordt gemotiveerd door het gebrek aan gedetailleerde kennis omtrent de micro-economische grondslag van ongelijkheid en de consequenties daarvan voor economische prestaties. Experimentele data hebben het voordeel dat het gedrag van individuen uitgelokt kan worden door beloningen met geld in een gecontroleerde setting. Met het uitvoeren van deze experimenten wordt in het eerste gedeelte van dit proefschrift geprobeerd de 'missing link' tussen ongelijkheid en de geneigdheid tot samenwerking, en de gevolgen daarvan voor economische groei, te identificeren.

De meeste macro-economische modellen stellen ons niet in staat de strategische interactie van de actoren te observeren omdat verondersteld wordt dat armen en rijken geïsoleerd van elkaar werken (cf. Aghion en Bolton, 1997). Maar in het echte leven is productie in essentie een groepsproces: arbeiders werken bijna altijd in ondernemingen of andere sociale organisaties. In dit proefschrift wordt daarom een theoretisch model ontwikkeld dat het mogelijk maakt de relatie te leggen tussen individuele productie-inspanningen en maatschappelijke productie. Het experiment vergelijkt 'out-of-equilibrium'-gedrag door in een laboratoriumsituatie de mate van coöperatie onder verschillende treatments te meten. In het algemeen stelt het experiment ons in staat te onderzoeken of hetzelfde niveau van ongelijkheid coöperatief gedrag op verschillende manieren kan beïnvloeden, afhankelijk van de omstandigheden waarin die ongelijkheid historisch is ontstaan. De bevindingen suggereren dat niet zozeer ongelijkheid als zodanig de bereidheid tot samenwerking beïnvloedt, maar dat veeleer de perceptie van de 'fairness' van de ongelijkheid een rol speelt. Om de empirische relevantie daarvan te testen, werden in het voorjaar van 2002 experimenten uitgevoerd met studenten in Tilburg. We vinden een sterk en negatief effect van ongelijkheid op groei, maar alleen als die ongelijkheid het gevolg is van doelbewuste acties van sommige leden van de samenleving.

In hoofdstuk 2 wordt alleen het effect van één dimensie van heterogeniteit, ongelijkheid, op de bereidheid tot coöperatie onderzocht. In hoofdstuk 3 wordt het

onderzoeksproject een stap verder gebracht. In de literatuur wordt door sommige auteurs geclaimd dat niet alleen inkomensongelijkheid, maar ook raciale of etnische fragmentatie medebepalend zijn voor de bereidheid tot samenwerking. De vraag die we hier aan de orde stellen is of het vooral de inkomensongelijkheid is dan wel de etniciteit, die effect heeft op de bereidheid tot samenwerking. Onze experimenten zijn de eerste waarin geprobeerd wordt de twee grote scheidslijnen die kunnen bestaan binnen heterogene samenlevingen – die tussen etnische groepen en tussen inkomensgroepen – te ontrafelen. Om die vraag te kunnen beantwoorden moest het experiment worden uitgevoerd in een samenleving waarin beide dimensies aanwezig zijn. Zuid-Afrika is zo'n land, omdat het gekarakteriseerd wordt door een grote heterogeniteit in zowel de etnische dimensie als de inkomensdimensie. Daarom voerden we in 2003 'trust-game' experimenten uit op respectievelijk door blanken en zwarten gedomineerde universiteiten in Zuid-Afrika; we gingen na in welke mate raciale verschillen en inkomensverschillen binnen en tussen groepen economische ontwikkeling belemmeren.

Verrassend genoeg vinden we geen effecten van etniciteit op zichzelf; we vinden wel dat inkomensongelijkheid afgunst toevoegt aan raciale verschillen. Bovendien kan vastgesteld worden dat leden van een samenleving eerder geneigd zijn tot terugbetalen wanneer ze denken dat economische prestaties eerlijk tot stand zijn gekomen. Samenvattend, de experimenten bieden ons een belangrijk inzicht: de perceptie van ongelijkheid vormt een belangrijk element in de beïnvloeding van de geneigdheid tot samenwerking.

De economische experimenten kunnen echter niet alle gestelde vragen beantwoorden. Het is bijvoorbeeld moeilijk om de resultaten van economische experimenten te extrapoleren naar het macro-economische beleid omdat economische experimenten per definitie niets kunnen zeggen over de grootte van de coëfficiënten. In een poging de micro-economische resultaten macro-economische substantie te geven, wordt - om de effecten van ongelijkheid op economische groei te bepalen - in dit proefschrift (hoofdstuk 6) gebruik gemaakt van zowel 'single period cross-section' data als van paneldata over de periode 1980-2000. In tegenstelling tot eerdere bevindingen met betrekking tot de ongelijkheid-groei regressies, levert dit

hoofdstuk een consistente boodschap op: de coëfficiënt voor interactie tussen ongelijkheid en corruptie is negatief en statistisch significant, hetgeen suggereert dat de wijze waarop ongelijkheid tot stand komt er meer toe doet dan ongelijkheid op zichzelf. Dat wil zeggen, wanneer ongelijkheid de uitkomst is van marktwerking die door de burgers als eerlijk wordt ervaren, heeft deze geen negatief effect op economische groei. Als ongelijkheid echter het resultaat is van handelen dat als 'unfair' wordt beschouwd, dan voorspelt de theorie een geringe neiging tot samenwerken in productieve activiteiten, wat leidt tot een negatieve correlatie tussen ongelijkheid en groei. Dat is precies wat we vinden.

Er zijn een aantal beleidsvraagstukken waarvoor een ruimere visie op ongelijkheid nodig is. Bij het ontwerpen van een belastingsysteem om geld te krijgen voor de publieke uitgaven, is de vorm van de inkomensverdeling belangrijk om het geschikte belastingstelsel te bepalen. De vorm van de hele inkomensdistributie is dus relevant voor bepaalde beleidsonderwerpen. Dit leidde tot een hernieuwde belangstelling voor de fundamentele afruil tussen efficiëntie (groei) en gelijkheid (sociale rechtvaardigheid), waarbij het eerste meer ongelijkheid vereist en het laatste zou vragen om herverdeling via het politieke proces. Het is echter niet geheel duidelijk hoe ongelijkheid economische groei beïnvloedt via het kanaal van de politieke economie. Allereerst zijn er geen overtuigende empirische resultaten voor de politiek-economische modellen; het is niet zo dat grotere inkomensongelijkheid leidt tot een hoger niveau van herverdeling via belastingen. Mis-schien wordt fiscale herverdeling beperkt door de kosten die veroorzaakt worden doordat belastingen marktprikkels verstoren, en door het lobbyen van de hoge inkomensgroepen en door diverse onvolmaaktheden die inherent zijn aan het politieke proces dat het belastingsysteem bepaalt. Op de tweede plaats wordt niet goed begrepen hoe ongelijkheid en groei gezamenlijk bepaald worden in een dynamisch politiek evenwicht. En last but not least, herverdeling is niet altijd slecht voor groei. Het tegenovergestelde zou wel eens waar kunnen zijn; in samenlevingen bijvoorbeeld waar de financiële markten slecht ont-wikkeld zijn, biedt herverdeling ongeschoolde individuen de gelegenheid te investeren in de accumulatie van menselijk kapitaal en in profijtelijke projecten. De relatie tussen economische groei en hoogte van de belastingen lijkt

niet-monotoon te zijn.

In het tweede deel van het proefschrift (hoofdstuk 4 en 5) wordt gepoogd een theoretisch model te ontwikkelen waarin de hiervoor genoemde kwesties aan de orde komen. De meeste politiek-economische evenwichtsmodellen zich richten op deze zaken bieden een uitstekend inzicht in het fenomeen herverdeling. Ze beperken zich echter tot de vraag hoe een gegeven initiële inkomens- of vermogensverdeling de herverdeling (groei) beïnvloedt waardoor de simultane bepaling van ongelijkheid, herverdeling en groei genegeerd wordt.

Het theoretisch model dat we ontwikkelen beoogt een geïntegreerde, dynamische theo-rie te ontwikkelen, waarin herverdeling zowel groei versterkende als groei remmende effecten heeft. Wij beweren dat de verschillende argumenten met betrekking tot het effect van herverdeling op groei elkaar niet uitsluiten, maar juist complementair zijn aan elkaar. Wij bieden een model van de dynamische krachten die leiden tot politieke uitkomsten en vervolgens van de effecten van deze uitkomsten op economische groei. We benadrukken daarbij in het bijzonder de rol van de dynamiek van de ongelijkheid als zowel een determinant als een resultaat van politieke en economische processen. We behandelen dit onderwerp door de economische en politieke processen te modelleren als intrinsiek verschillende, maar interacterende domeinen. In dit gedeelte van het proefschrift wordt dat gedaan door volgende modificaties toe te staan.

Ten eerste wordt in onze theorie de veronderstelling dat agenten identieke mogelijkheden en voorkeuren hebben - de zogenaamde 'representatieve agent'-aanname - afgezwakt. In plaats daarvan wordt een model ontwikkeld met overlappende generaties waarin agenten verschillende vermogensniveaus hebben, die leiden tot verschillen in vaardigheden, inkomens en politieke voorkeuren. Modellen die gebaseerd zijn op de aanname dat de meerderheid de uitkomst van het politieke proces bepaalt – de zogenaamde 'majority voting' modellen - vormen wellicht geen goede representatie van de politieke werkelijkheid en zijn daarmee onbevredigend als een positieve theorie van herverdeling (Rodriguez, 2000). Daarom gebruiken we niet de mediane-kiezerbenadering die uitgaat van een over de tijd invariante verdeling, maar bekijken in plaats daarvan hoe de ontwikkeling van de bezittin-

gen de politieke besluitvorming over herverdeling beïnvloedt. Daarbij gaan we uit van een pressiegroepenmodel waarin lobbyen een investering van tijd is. Dat wil zeggen, we veronderstellen dat zowel leden van de pressiegroep van geschoolden als leden van de groep van ongeschoolden moeten besluiten over de wijze waarop ze de tijd verdelen tussen arbeid en lobby-activiteiten. Aangetoond wordt dat de optimale hoeveelheid werk en lobby-inspanningen bepaald wordt door de conditie dat de marginale baten van lobbyen gelijk zijn aan het individueel loon. Als er toevallig sprake is van technische vooruitgang, hetgeen een toename impliceert in het loon van geschoolde arbeiders, wordt het voor de ongeschoolden aantrekkelijk meer te lobbyen en minder te werken. Dit leidt tot een toename van de belasting die gebruikt wordt voor intra-generationele herverdeling. Dit resulteert vervolgens in een toename van het aantal geschoolde arbeiders. Omdat de politieke uitkomst niet alleen afhankelijk is van politieke actie maar ook van de omvang van de groep, ontstaat een systeem waarin belastingenveranderingen uiteindelijk geblokkeerd worden door tegengestelde krachten.

Op de tweede plaats blijkt het al jaren moeilijk te verklaren waarom bij het onderhandelen met politici belangengroeperingen ontstaan en uit elkaar vallen. Bestaande politiek-economische modellen negeren de dynamische aspecten van het politieke proces en richten de aandacht op endogene beleidsmodellen met belangengroepen van een vaste omvang. In dit gedeelte van het proefschrift worden politieke besluiten echter gerelateerd aan economische variabelen, en niet alleen aan politieke settings. In het bijzonder wordt ingegaan op de dynamiek van politieke keuze en op hoe de strategieën van belangengroepen in zo'n setting kunnen veranderen. Het effect daarvan is dat de groepsomvang endogeen wordt en het tijdpad van herverdeling volgt en dus met de tijd varieert.

Op de derde plaats, in Alesina en Rodrik (1994) en in Persson en Tabellini (1994) is de inkomensverdeling vooraf bepaald en blijft die constant. In werkelijkheid echter beïnvloedt de economische groei zelf de inkomensverdeling. Om de dynamiek van herverde-ling te analyseren, moet een economische theorie niet alleen rekening houden met de effecten van beleid op economisch gedrag, maar ook met de terugkoppeling van economisch gedrag op politieke uitkomsten. Politiek-

economische beschouwingen moeten namelijk geïntegreerd worden in dynamische macro-economische modellen. In het tweede deel van dit proefschrift wordt daar rekening mee gehouden. Dat deel presenteert een theoretisch model voor het analyseren van de dynamiek van de accumulatie van menselijk kapitaal en ongelijkheid door de introductie van mechanismen van endogene herverdeling en technologische vooruitgang in het model. Het ontwikkelingspatroon van ongelijkheid, belastingen, politieke activiteit, menselijk kapitaal en economische groei naar een stabiele toestand wordt geïllustreerd aan de hand van numerieke simulaties. Dit model wordt verrijkt door ook de mogelijkheid mee te nemen dat erg rijke individuen bijdragen betalen aan politici om vrijgesteld te worden van het betalen van belastingen. De motivatie hiervoor is dat initiële ongelijkheid - voor belastingheffing -niet altijd leidt tot een hogere mate van herverdeling. Dit zou kunnen verklaren waarom empirische studies er niet in slagen een positieve samenhang te vinden tussen ongelijkheid en herverdeling.

Recente politiek-economische modellen (cf. Grossman en Helpman, 1994) behandelen de casus van veel actoren met verschillende preferenties door uit te gaan van een sociale planner (de regering) die een gewogen som van het nut van individuen en geldelijke bijdragen maximeert. In de meeste van deze modellen kent de regering vaste, exogene gewichten toe aan de verschillende onderdelen van de besluitvormingsfunctie, zeg μ aan de geaggregeerde welvaart van individuen en 1-μ aan steekpenningen. Belangrijk in hoofdstuk 5 is het feit dat twee stromen uit de literatuur over politiek-economische modellen samengevoegd worden, waardoor we in staat zijn de gewichten in de politieke besluitvormingsfunctie te endogeniseren. Dit betekent dat de wijze waarop de μ in een politiek-economisch evenwicht bepaald wordt, en hoe deze beslissing op haar beurt de accumulatie van menselijk kapitaal en groei beïnvloedt, in een dynamische setting geanalyseerd wordt. We gebruiken een pressiegroepmodel van het Becker-type (1984), dat actieve participatie van potentiële stemmers veronderstelt in de vorm van lobby-activiteiten om de politiek te beïnvloeden. Ons model van het politieke proces omvat ook een model van omkoperij; dit dient als leidraad voor het empirisch werk dat in hoofdstuk 7 besproken wordt.

Gegeven deze politieke en economische setting, vragen we ons af of het dynamische politieke proces leidt tot een groei-versterkende herverdeling. In ons model zijn dus de inkomensverdeling, de accumulatie van menselijk kapitaal, de groeivoet, de hoogte van de belasting en het gewicht dat de sociale planner aan de samenleving hecht simultaan endogeen en worden geanalyseerd in een dynamische setting. Gegeven de endogeniteit van de hiervoor genoemde variabelen, bouwen we vergelijkingssystemen en schatten we het model waarbij gebruik gemaakt wordt van de driestaps kleinste-kwadratenmethode om de relatie tussen de variabelen te analyseren. Daarnaast worden ook schattingen op basis van paneldata gepresenteerd. De bevindingen zijn dat zowel corruptie als ongelijkheid de belastingen als fractie van het Bruto Binnenlands Product (BBP) significant reduceert en dat de relatie tussen de effectieve belastingvoet en de groeivoet van het BBP niet-lineair is, evenals de relatie tussen het onderwijsniveau en de groei.

Bibliography

[1] Abbink, K., Irlenbusch B. and Elke R. (2000) "The Moonlighting Game - An Experimental Study on Reciprocity and Retribution" *Journal of Economic Behavior and Organization* **42**: 265-277.

[2] Acemoglu, D. (1998) "Why do new technologies complement skills? Directed technical change and wage rigidity" *Quarterly Journal of Economics* **113:** 1055-1089.

[3] Acemoglu, D. (1999) "Changes in unemployment and wage inequality: an alternative theory and some evidence" *American Economic Review* **89**, 1259-1278.

[4] Acemoglu, D. and Robinson, J.A. (2001) "Inefficient Redistribution" *American Political Science Review* **95**: 649-661.

[5] Addison, T. and Rahman, A. (2001) "Why is So Little Spent on Educating the Poor?" WIDER Discussion Paper 2001/29, Helsinki: WIDER (http://www.wider.unu.edu/discussion papers)

[6] Aidt, T.S. (1997) "Strategic Entry, Rent Seeking and Transfers" University of Aarhus Working Paper 1997-2021.

[7] Aghion, P. and Bolton, P. (1997) "A Theory of Trickle-Down Growth and Development" *Review of Economic Studies* **64**: 151-172.

[8] Aghion, P., Eve, C. and Garcia-Penalosa, C. (1999) "Inequality and Economic Growth: The Perspective of the New Growth Theories" *Journal of Economic Literature* **37:** 1615-1660.

[9] Alesina, A., Baqir, R. and Easterly, W. (1999) "Public Goods and Ethnic Divisions" *Quarterly Journal of Economics* **114**: 1243-1284.

[10] Alesina, A. and La Ferrara, E. (2002) "Who Trust Others" *Journal of Public Economics* **85**: 207-234.

[11] Alesina, A. and Perotti, R. (1996) "Income Distribution, Political Instability, and Investment" *European Economic Review* **40**: 1203-28.

[12] Alesina, A. and Rodrik, D. (1994) "Distributive Politics and Economic Growth" *Quarterly Journal of Economics* **108**: 465-490.

[13] Alesina, A., and Angeletos, G.M. (2005) "Fairness and Redistribution," Harvard Institute of Economic Research Discussion Paper No. 2070.

[14] Atkinson, A. and Brandolini, A. (2001) "Promise and Pitfalls in the Use of 'Secondary' Data-Sets: Income Inequality in OECD countries as a Case Study" *Journal of Economic Literature* **39**: 771-799.

[15] Baron, D. (2002) "Review of Grossman and Helpman's: Special Interest Politics" *Journal of Economic Literature* **40**: 1221-1229.

[16] Barr, A. (2003) "Trust and Expected Trustworthiness: Experimental Evidence From Zimbabwean Villages" *Economic Journal* **113**: 614-630.

[17] Barro, R. (1991) "Economic Growth in a Cross Section of Countries" *Quarterly Journal of Economics* **106**: 407-44.

[18] Barro, R. (2000) "Inequality and Growth in a Panel of Countries" *Journal of Economic Growth* **5**: 5-32

[19] Banerjee, A.V. and Duflo, E. (2003) "Inequality and Growth: What Can the Data Say?" MIT working paper.

[20] Becker, G.S. (1983) "A Theory of Competition among Pressure Groups for Political Influence" *Quarterly Journal of Economics* **98**: 371-400.

[21] Becker, G.S. (1985) "Public Policies, Pressure Groups and Dead Weight Costs" *Journal of Public Economics* **28** : 329-347.

[22] Bellemare, C., and Kroeger, S. (2003) "On Representative Trust" CentER Discussion Paper Series, No. 2003-47, Tilburg University, Tilburg, The Netherlands.

[23] Benabou, R. (1996) "Heterogeneity, Stratification and Growth, in Macroeconomics Annual", Cambridge, MA, NBER.

[24] Benabou, R. (2000) "Unequal Societies: Income Distribution and the Social Contract" *American Economic Review* **90**: 96-129.

[25] Benhabib, J. and Rustichini, A. (1996) "Social Conflict and Growth" *Journal of Economic Growth* **1**: 125-142.

[26] Benjamin, D., Loren, B. and John, G. (2004) "The Dynamics of Inequality and Growth in rural China: Does Higher Inequality Impede Growth?" Working paper, University of Toronto.

[27] Berg, J., Dickhaut, J. and McCabe, K. (1995) "Trust, Reciprocity and Social History" *Games and Economic Behavior* **10**: 122-142.

[28] Bernheim, B.D. and Whinston, M.D. (1986) "Menu Auctions, Resource Allocation and Economic Influence" *Quarterly Journal of Economics* **101**: 1-31

[29] Bertola, G. (1993) "Factor Shares and Savings in Endogenous Growth" *American Economic Review* **83**: 1184-1198.

[30] Blount, S. (1995) "When Social Outcomes Aren't Fair: The Effect of Causal Attributions on Preferences," *Organizational Behavior and Human Decision Processes*, **63**: 131-144.

[31] Bosman, R. and Winden, F. (2002) "Emotional hazard in a power-to-take game experiment" *Economic Journal* **112**: 147-169.

[32] Bourguignon, F. and Verdier, T. (2000) "Oligarchy, democracy, inequality and growth" *Journal of Development Economics* **62**: 285-313.

[33] Bourguignon, F. and Morrison, C. (2002) "Inequality among World Citzens" *American Economic Review* **92:** 727-744.

[34] Burns, J. (2003) "Insider-Outsider Distinctions in South Africa: The impact of race on the behavior of High School Students" Conference on Field Experiments in Economics, Middlebury College, Middlebury VT.

[35] Cameroon, D. (1988) "Distributional Coalitions and other Sources of Economic Stagnation: On Olson's Rise and Decline of Nations" *International Organization* **42**: 561-603.

[36] Camerer, C. (2003) Behavioural Game Theory: Experiments on Strategic Interaction. Princeton University Press. Princeton.

[37] Canton, E.J.F., De Groot, H.L.F. and Nahuis, R. (2002) "Vested Interests and Resistance to Technology Adoption" *Journal of European Political Economy* **18**, 631-652.

[38] Carter, M.R. and Castillo, M. (2002) "The Economic Impact of Altruism, Trust and Reciprocity: An Experimental Approach to Social Capital" *Agricultural and Applied Economics*, Staff Paper No. 448.

[39] Chan, K.S., Mestelman, S., Rob, M. and Andrew, M. (1996) "The voluntary Provision of Public Goods under Varying Income Distributions" *Canadian Journal of Economics* **15**: 54-69.

[40] Chan, K.S., and Mestelman, S. Rob M. and Andrew, M. (1999) "Heterogeneity and The Voluntary Provision of Public Goods" *Experimental Economics* **2**: 5-30.

[41] Clark, G. (1995) "More evidence on Income Distribution and Growth" *Journal of Development Economics* **47**: 403-427.

[42] Conway, M. (1991) "Political Participation in the United States" Washington DC: U.S. Congressional Quarterly Press.

[43] Damania, R. (2001) "When the Weak Win: The Role of Investment in Environmental Lobbying" *Journal of Environmental Economics and Management* **42**: 1-22.

[44] Deininger, K. and Squire, L. (1996) "Measuring income Inequality: a New data base" *World Bank Economic Review* **10**: 565-591.

[45] Deininger, K. and Squire, L. (1998) "New ways of looking at old Issues: Inequality and Growth" *Journal of Development Economics* **57**: 259-287.

[46] Deininger, K. and Olinto, P. (2000) "Asset Distribution, Inequality and Growth" World Bank working Paper 2375.

[47] Easterly, W. (2001) "Inequality does cause underdevelopment: New Evidence from Commodity Endowments, Middle class share and Other Determinants of per capita Income" World Bank Working Paper.

[48] Easterly, W. and Sergio, R. (1993) "Fiscal Policy and Growth" *Journal of Monetary Economics* **32**: 417-58.

[49] Easterly, W. and Levine, R. (1997) "Africa's Growth Tragedy: Policies and Ethnic Divisions" *Quarterly Journal of Economics* **112**: 1203-1250.

[50] Eckel, C. and Wilson, K. (2003) "Conditional Trust: Sex, race and facial expressions in a trust game" Working Paper presented at "Trust and Institutions," a conference held at Harvard University.

[51] Ehrlich, I. and Francis, T. (1999) "Bureaucratic Corruption and Endogenous Economic Growth" *Journal of Political Economy* **107**: 270-293.

[52] Fehr, E. and Bettina, R. (2003) "Detrimental Effects of Sanctions on Human Altruism" *Nature* **422**: 137-140.

[53] Fehr, E., Falk, A. and Fischbacher, U. (2000) "Testing Theories of Fairness" Working paper 63, University of Zurich.

[54] Fershtman, C. and Gneezy, U. (2001) "Discrimination in a Segmented Society: An Experimental Approach" *Quarterly Journal of Economics* **116**: 351-377.

[55] Figini, P. (1999) "Inequality and Growth Revisited", Trinity and College,Trinity Economic Paper Series, Paper No.99/2.

[56] Filer, J., Kenny, L. and Morton B. (1993) "Redistribution, Income and Voting" *American Journal of Political Science* **37**: 63-87.

[57] Forbes, K. (2000) "A Reassessment of the Relationships between Inequality and Growth" *American Economic Review* **90**: 869-886.

[58] Galbraith, J. and Kum, L. (2004) "Estimating the Inequality of Household Incomes: A Statistical Approach to the Creation of a Dense and Consistent Global Data Set" Univeristy of Texas Inequality Project (UTIP) Working Paper No. 22.

[59] Galor, O. and Zeira, J. (1993) "Income Distribution and Macroeconomics" *Review of Economic Studies* **60**: 35-52.

[60] Galor, O. and Moav, O. (2004) "From Physical Capital to Human Capital: Inequality and the Process of Development" *Review of Economic Studies* **79:** 1001-1026.

[61] Ghosh, S. and Sarmistha, P. (2004) "The effect of Inequality on Growth: Theory and Evidence from the Indian States" *Review of Development Economics* **8**:164-177.

[62] Glaeser, E., Jose S., and Andrei, S. (2003) "The Injustice of Inequality" *Journal of Monetary Economics* **50**: 199-222.

[63] Glaeser, E., Laibson, D., Scheinkman, J.A. and Soutter, C.L. (2000) "Measuring Trust" *Quarterly Journal of Economics* **115**: 811-846.

[64] Gottschalk, P. and Smeeding, T.M (1997) "Cross-national Comparisons of earnings and Income Inequality" *Journal of Economic Literature* **105**: 633-687.

[65] Graichen, P., Requate, B. and Dijkstra, R. (2001) "How to Win the Political Contest: a Monopolist vs. Environmentalist" *Public Choice* **108**: 273-293.

[66] Greenwald, B. and Stiglitz, J. (1986) "Externalities in Markets with Imperfect Information and Incomplete Markets" *Quarterly Journal of Economics* **101**: 229-64.

[67] Güth, W. (1995) "An Evolutionary Approach to Explaining Cooperative Behavior by Reciprocal Incentives" *International Journal of Game Theory* **24:** 323-344.

[68] Haddad, L., Maluccio, A. and Julian, M. (1999) "Social Capital and Income Generation in South Africa, 1993-1998" Paper prepared for IDS-IFPRI Workshop.

[69] Haddad, L. and Maluccio, A. (2003) "Trust, Membership in Groups, and Household Welfare: Evidence from KwaZulu- Natal, South Africa" 573-600.

[70] Haile, D. (2005) "Wealth Distribution, Lobbying and Economic Growth: Theory and Evidence" WIDER Research Paper No. 2005/21

[71] Haile, D. (2005) "Genesis of Inequality Counts More than Inequality *Per Se*" Paper presented for Venice Summer Institute.

[72] Haile, D. and Meijdam, A. (2004) "Inequality, Redistribution and Growth" CentER discussion paper, No. 2004-94, Tilburg Univeristy, Tilburg, The Netherlands.

[73] Haile, D., Sadrieh, A. and Verbon, H.A.A. (2003) "Self-Serving Dictators and Economic Growth" CESIfo working paper NO.1105

[74] Hofstede, G. and Gert Jan, H. (2004) "Cultures and Organizations: Software of the Mind" New York, Mcgraw-Hill, U.S.A.

[75] Islam, N. (1995) "Growth Empirics: A Panel Data Approach" *Quarterly Journal of Economics* **110:** 1127-1170.

[76] Filer J., Lawrence W. and Rebecca B. (1993) "Redistribution, Income and Voting" *American Journal of Political Science* **37**: 63-87.

[77] Kaldor, N. (1956) "Alternative Theories of Distribution" *Review of Economic Studies* **23**: 94-100.

[78] Keefer, P. and Knack, S. (1997) "Does Social Capital Have an Economic Payoff? A Cross-Country Investigation" *Quarterly Journal of Economics* **112:** 1251-88.

[79] Keefer, P. and Knack, S. (2000) "Polarization, Politics and Property Rights: Links between Inequality and Growth" World Bank working Paper 2418.

[80] Knack, S. and Zak, P. (2001) "Trust and Economic Growth" *The Economic Journal* **111**: 295-321.

[81] Kneller, R., Bleamy, F. and Gemmel, N. (1999) "Fiscal Policy and Growth: evidence from OECD countries" *Journal of Public Economics* **74**: 171-190.

[82] Kuznets, S. (1955) "Economic Growth and Income Inequality" *American Economic Review* **45**: 1-28.

[83] Kruger, A. (1993) "How Computers Have Changed the Wage Structure: Evidence from Micro Data" *Quarterly Journal of Economics* **108:** 33-60.

[84] La Ferrara, E. (2002) "Inequality and group participation: theory and evidence from rural Tanzania" *Journal of Public Economics* **85**: 235-273.

[85] Lambart, P. (1993) "The Distribution and Redistribution of Income" Manchester University Press.

[86] Lambsdorff, J. (2002) "Background Paper to the 2002 Corruption Perceptions Index Framework Document " Transparency International and University of Göttingen. (http://www.transparency.org)

[87] La Porta, R., Lopez-de-Silanes, A. Shleifer, F. and Vishny, R. (1997) "Trust in Large Organizations" *American Economic Review Papers and Proceedings*, **87**: 333-38.

[88] La Porta, R., Lopez-De-Silanes, A., Shleifer, F. and Vishny, R. (1999) "The Quality of Government" *The Journal of Law, Economics and Organizations* **15**: 222-79.

[89] Li, H. and Heng-fu, Z. (1998) "Income Inequality Is not Harmful for Growth: Theory and Evidence" *Review of Development Economics* **2**: 318-34.

[90] Lindbeck, A. and Dennis, J. (1999) "Wage Setting, Unemployment and Insider-Outsider Relations" *American Economic Review, Papers and Proceedings* **76**: 235-9.

[91] Lunderberg, M. and Squire, L. (2003) "The Simultaneous Evolution of Growth and Inequality" *The Economic Journal* **113**: 326-344.

[92] Martin, D. and Kirchsteiger, G. (1998) "A Theory of Sequential Reciprocity," CentER discussion paper, No. 1998-37, Tilburg University, Tilburg, The Netherlands.

[93] Mauro, P. (1995) "Corruption and Growth," *Quarterly Journal of Economics* **110:** 681-712.

[94] Mirrlees, J. (1971) "An Exploration in the Theory of Optimum Income Taxation" *Review of Economic Studies* **38**: 175-208.

[95] Mulligan, C.B. and Sala-i-Martin, X. (1999) "Gerontocracy, Retirement and Social Security" NBER Working Paper 7117.

[96] North, D. (1990) "A Transaction Cost Theory of Politics" *Journal of Theoretical Politics* **2**: 255-67.

[97] Olson, M. (1965) "The logic of Collective Action" MA: Harvard University Press.

[98] Olson, M. (1982) "The rise and decline of Nations" New Haven: Yale University Press.

[99] Patridge, M. (1997) "Is Inequality Harmful for Growth? Comment" *American Economic Review* **87**: 1019-1032.

[100] Perotti, R. (1994) "Political Equilibrium, Income Distribution and Growth" *Review of Economic Studies* **60**: 755-76.

[101] Perotti, R. (1996) "Democracy, Income Distribution and Growth: What the Data Says" *Journal of Economic Growth* **1**:149-187.

[102] Persson, T. and Tabellini, G. (1994) "Is Inequality Harmful for Growth?" *American Economic Review* **84**: 600-21.

[103] Pineda, J. and Rodriguez, F. (2000) "The Poltical Economy of Human Capital Accumulation" mimeo. Univeristy of Maryland at College Park.

[104] Rabin, M. (1993) "Incorporating Fairness into Game Theory and Economics" *American Economic Review* **83**: 1281-1302.

[105] Radcliff, B. (1992) "The Welfare State, Turnout, and the Economy: A Comparative Analysis" *The American Political Science Review* **86**: 444-454.

[106] Ravallion, M. (1998) "Does Aggregation Hide the Harmful Effects of Inequality on Growth" *Economics Letters* **61:** 73-77.

[107] Rodriguez, F. (1999) "Does Inequality lead to Redistribution? Evidence from The United States" *Economics and Politics* **11**: 2-20.

[108] Rose, A. (2001) "Corruption and Government: Causes, Consequences and Reform" Cambridge University Press, New York 16.

[109] Rosenstone, S. and Hansen, J. (1993) "Mobilization, Participation and Democracy in America" New York: MacMillan.

[110] Roth, E. (1995) "Bargaining Experiments," in Kagel, John and Alvin E. Roth (eds): Handbook of Experimental Economics. Princeton, NJ: Princeton University Press.

[111] Sadrieh, K., and Verbon, H.A.A. (2005) "Inequality, Trust and Growth" forthcoming in *European Economic Review*

[112] Saint-Paul, G. and Verdier, G. (1993) "Education, Democracy and Growth" *Journal of Development Economics* **42**: 399-407.

[113] Sala-i-Martin, X. (1996) "A positive Theory of Social Security" *Journal of Economic Growth* **1**: 277-304.

[114] Servaas van der, B. and Ronelle, B. (2000) "The stories behind the numbers: an investigation of efforts to deliver services to the South African poor" World Bank Working Paper No 26935.

[115] Stewart, F. (2002) "*Horizontal Inequalities: A Neglected Dimension of Development*" WIDER Working paper No. 81.

[116] Tanzi, V. (1998) "Fundamental Determinants of Inequality and the Role of Government" IMF Working Papers 98/178

[117] Temple, J. (1999) "The New Growth Evidence" *Journal of Economic Literature* **37**: 112-56.

[118] The *Economist.* (2002) "Angola: Measuring Corruption" October **26**: 48.

[119] Theo, L. (2001) "Public Pensions and Population Aging: An Economic Analysis of Fertility, Migration and Social-Security Policy" No. 86

[120] Warr, P. (1983) "The Private Provision of a Public Good is Independent of the Distribution of Income," *Economics Letters* **13:** 207-211.

[121] Williamson, J.G. (1999) " Inequality, Poverty, and History" Oxford: Blackwell.

[122] World Bank, (2002) "World Development Report 2001/2002: Attacking Poverty" Washington, DC: World Bank.